Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

JANUARY, 1948 TECHNOLOGY DEPARTMENT

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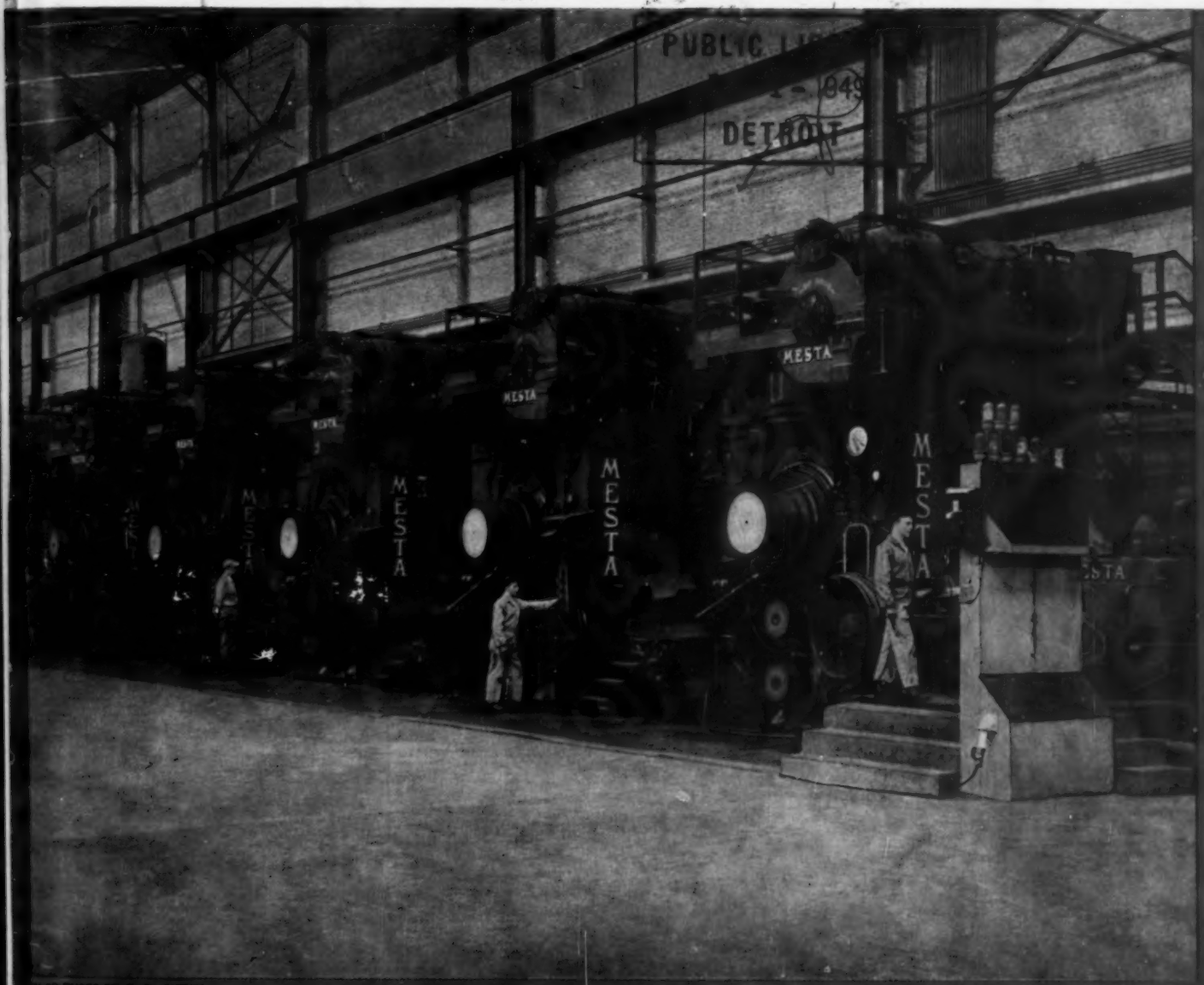


COLOR PHOTO BY E. H. MESTA

Mesta 68" Four-High Continuous Hot Strip Mill Finishing Stands

HOT STRIP MILLS
. . . designed and built by
MESTA

DESIGNERS AND BUILDERS OF COMPLETE STEEL PLANTS
MESTA MACHINE COMPANY · PITTSBURGH, PA.

R v.26 Jan.–June 1949

the Crane SAFETY LIMIT STOP

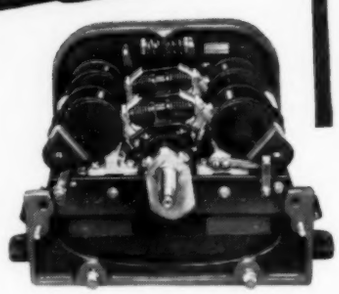
...THAT SET *New Standards of Performance*

There probably has never been a crane safety limit stop switch that so completely embodies *all* the wants of steel mill engineers as the Type P-100 Cutler-Hammer Safety Limit Stop, for 41 to 100 H.P. installations or the P-200 Safety Limit Stop for 101 to 200 H.P. installations. This is demonstrated by the fact that time after time engineers have taken one look at it and said: "That is what I want".

C-H Type P-100 100 H. P.

C-H Type P-200 200 H. P.

The photographs shown here tell their own story . . . a story of simple design . . . of rugged construction . . . of dependable, unfailing operation. The Cutler-Hammer Crane Safety Limit Stop has set new standards of performance every time, every way. CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wis. *Associate*: Canadian Cutler-Hammer, Ltd., Toronto.



Movable contacts and arc shields in position. (Operating head removed).

Inside view of removable head, showing snap action mechanism.

Combined operating lever and tripping weight.

CHECK THESE OUTSTANDING FEATURES

Low headroom required.

Totally enclosed tripping mechanism—can't be made inoperative by rain, snow, ice, dirt or falling objects.

Slate contact supports, slotted, provide ample insulation to ground.

Snap action make and break —hammer blow of tripping is absorbed by spring bumper.

Cover strong enough to support a man's weight.

Rigid one-piece construction of operating lever and tripping weight.

Only one hanging weight, and that has double guides, adjustable to meet any practical installation condition, to prevent fouling the weight by the hoisting cables.

The snap action is obtained from a compression spring, with a very low unit stress. Even if it should break, the mechanism will operate because spring is held in place by an inside guide.

Ball bearings, with means for lubricating by standard grease fittings, used throughout.

Flexible leads brought out for ease of installation.

Gasketed cover to keep out dirt.

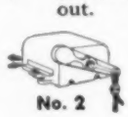
Mounting interchangeable with old style P-2.

Blowouts latched in place when mounted in position (3) or (4).

Cover chained to case to prevent dropping to ground during inspection.

(Below) Operating lever can be mounted in any of 4 quadrants.

No. 1



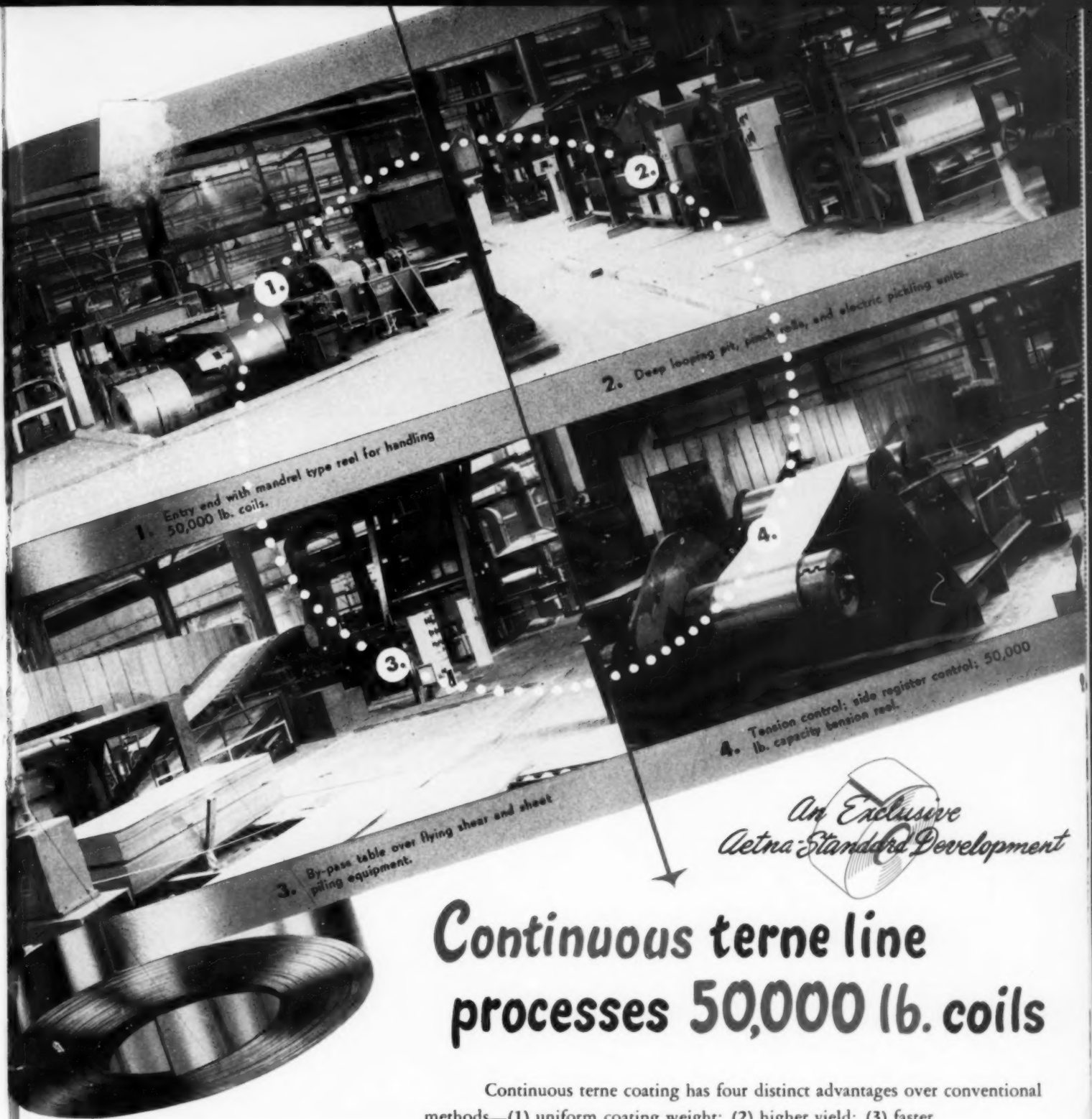
No. 2

No. 3

No. 4

CUTLER-HAMMER
MOTOR CONTROL
C-H

IRON AND STEEL ENGINEER, published monthly by Association of Iron and Steel Engineers, 1010 Empire Bldg., entered as second class matter January 25, 1924 at Pittsburgh, Pennsylvania, under Act of Congress March 3, 1879. $7.50 per year in United States, $8.25 Canada, $10.00 foreign countries. Volume 26, No. 1.


1. Entry end with mandrel type reel for handling 50,000 lb. coils.
2. Deep looping pit, pinch rolls, and electric pickling units.
3. By-pass table over flying shear and sheet piling equipment.
4. Tension control; side register control; 50,000 lb. capacity tension reel.

An Exclusive Aetna-Standard Development

Continuous terne line processes 50,000 lb. coils

Continuous terne coating has four distinct advantages over conventional methods—(1) uniform coating weight; (2) higher yield; (3) faster production; and (4) lower costs.

This is the second continuous wide terne line which Aetna-Standard has designed and installed. The first line, in operation for more than several years, has exceeded tonnage expectations. This second line, for 50,000 lb. coils, has been developed in co-operation with engineers of The Carnegie-Illinois Steel Corporation for the Gary, Indiana, plant.

Ask Aetna-Standard about continuous terne equipment . . . the only company with continuous terne knowledge and experience.

INTERESTING FACTS ABOUT CONTINUOUS TERNE LINE FOR CARNEGIE-ILLINOIS

- HANDLES 48" WIDE MATERIAL.
- MAXIMUM SPEED OF 150' PER MIN.
- SHEARS TO SHEET LENGTHS.
- RECOILS UP TO 50,000 LBS.
- ELECTROLYTIC PICKLING.
- IMMERSION HEATING OF POT.
- PATENTED VERTICAL DRY CLEANING

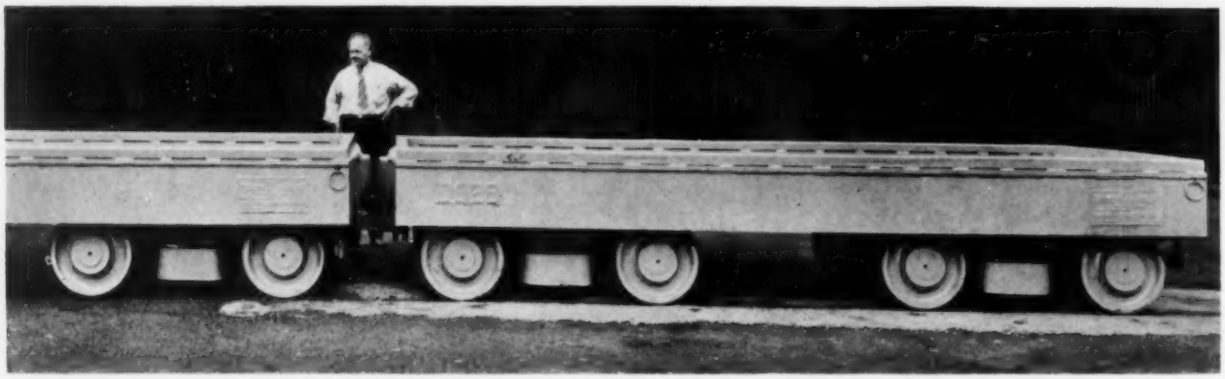
THE AETNA-STANDARD ENGINEERING CO.

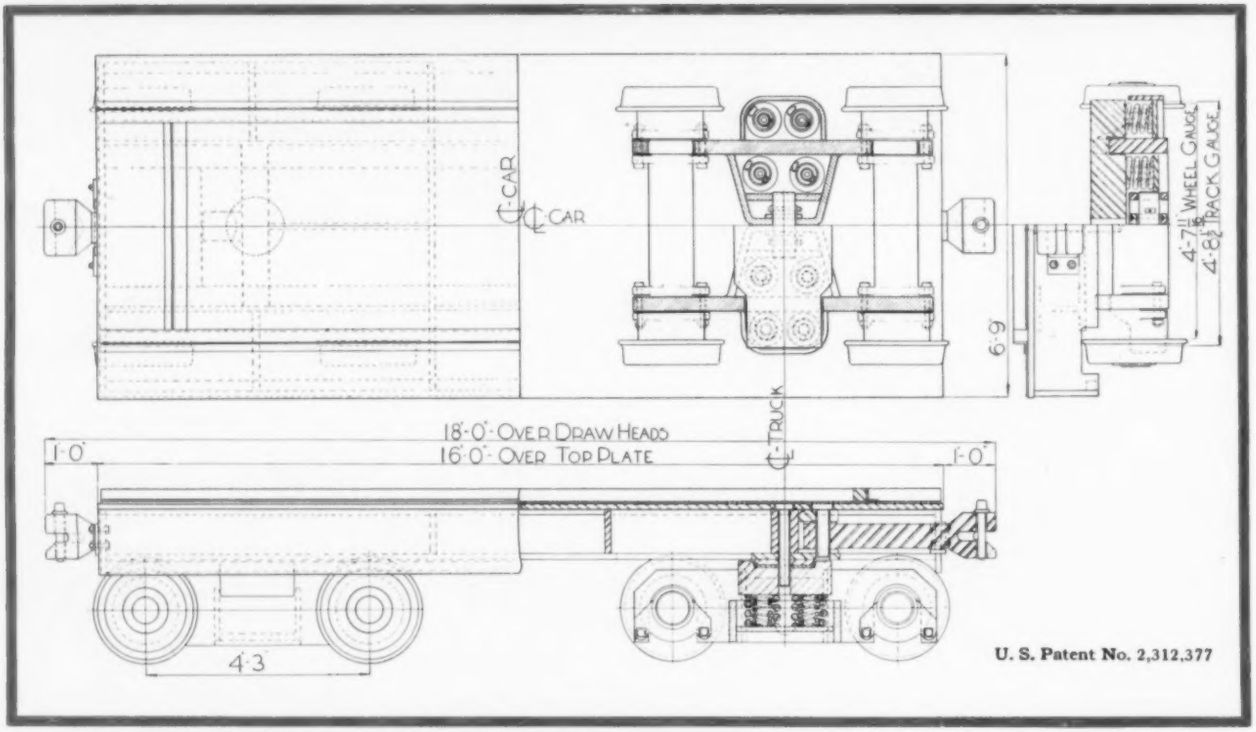
YOUNGSTOWN, OHIO

ASSOCIATED COMPANIES: HEAD, WRIGHTSON & COMPANY, LTD., THORNABY-ON-TEES, ENGLAND
AETNA-STANDARD ENGINEERING COMPANY, LTD. . . . TORONTO, ONTARIO, CANADA

TREADWELL

HEAVY DUTY WELDED INGOT MOULD CARS





Single Unit Body — Low Center of Gravity — Trucks Easily Removed — All Welded Construction — Body Overhung to Protect Trucks — Stool Rests to Meet Requirements — Ample Allowance for Stripper Load — Automatic or Link and Pin Couplers — Replaceable Floor Protection Plates — Drawbars to Operate with Present Equipment.

TREADWELL CONSTRUCTION COMPANY

MIDLAND, PENNA.

208 S. LA SALLE ST.
CHICAGO 4, ILL.

140 CEDAR STREET
NEW YORK 6, N. Y.

1217 FARMERS BANK BLDG.
PITTSBURGH 22, PA.

Improve your Competitive Position with

MORGAN WORCESTER ROLLING MILLS

Will you be ready when competitive selling returns? Many large producers of rolling mill products are preparing *now*. They are modernizing every phase of their operations with particular attention to plant layout and rolling mill equipment.

Why not let Morgan help you develop better, more accurate rolling mill products that you can sell in a competitive market?

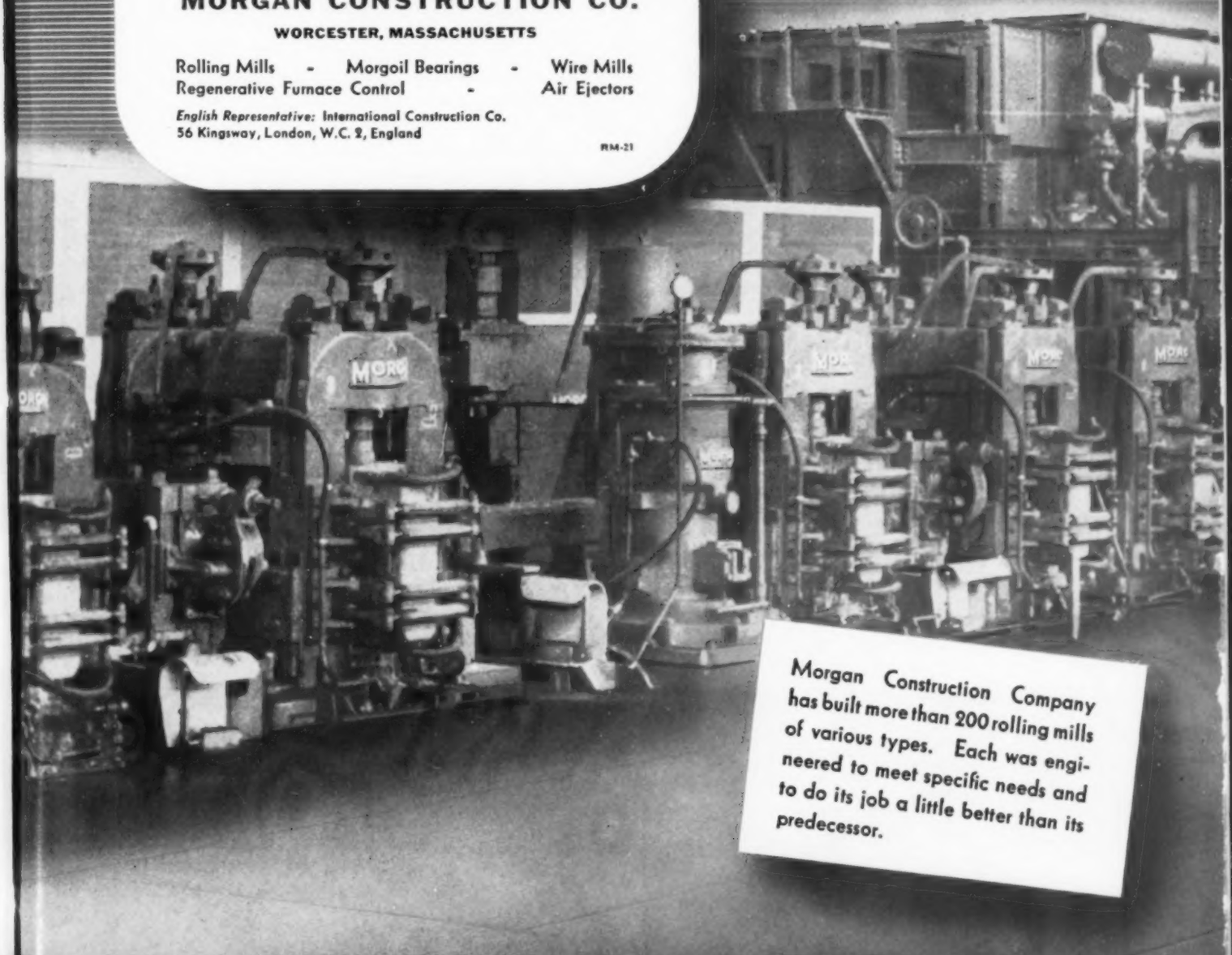
MORGAN CONSTRUCTION CO.

WORCESTER, MASSACHUSETTS

Rolling Mills - Morgoil Bearings - Wire Mills
Regenerative Furnace Control - Air Ejectors

English Representative: International Construction Co.
56 Kingsway, London, W.C. 2, England

RM-21



Morgan Construction Company has built more than 200 rolling mills of various types. Each was engineered to meet specific needs and to do its job a little better than its predecessor.

The Complete ElectroniK Story

POTENTIOMETER

New Catalog 15-13

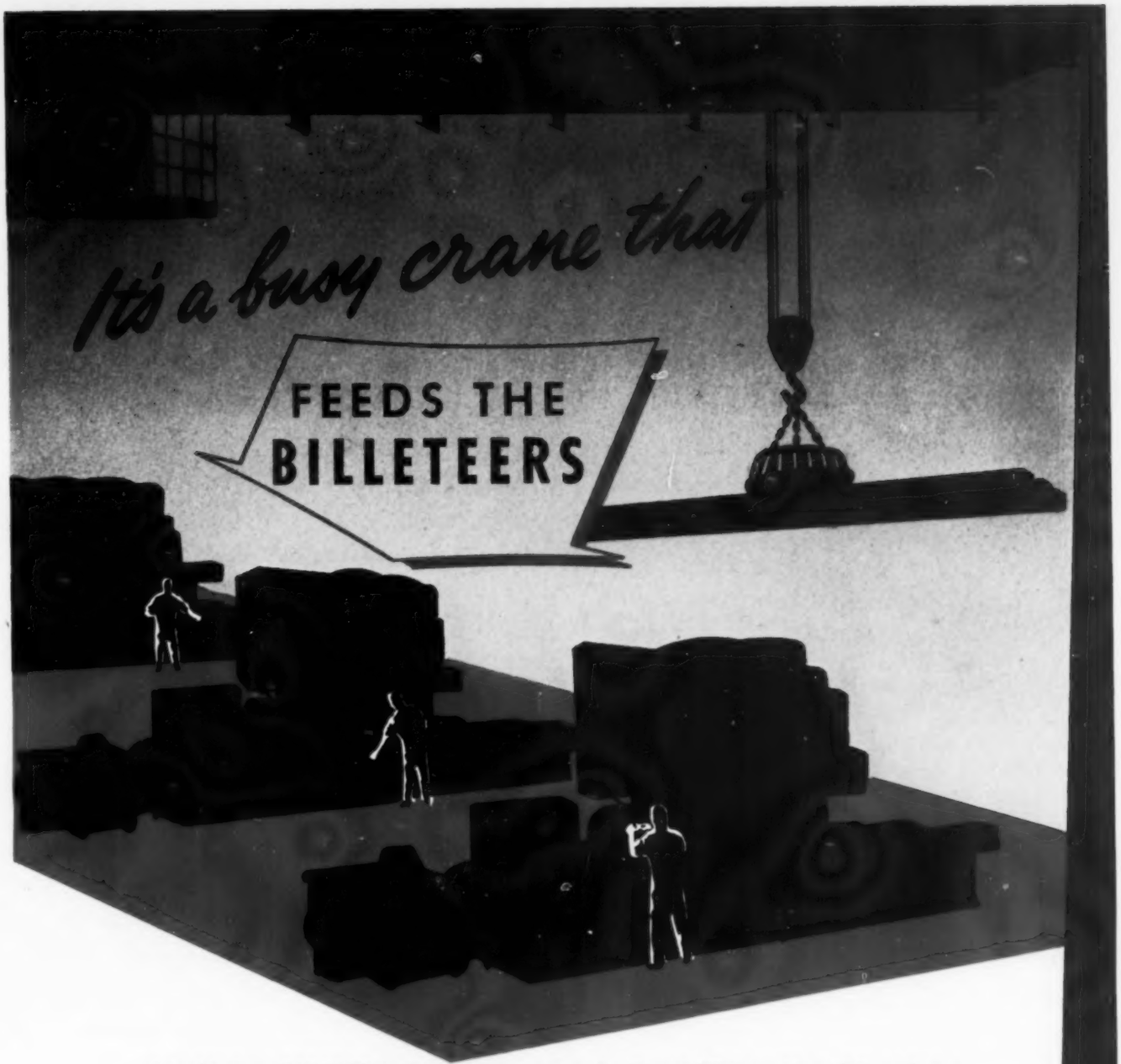
...Yours For The Asking!

There's a Brown ElectroniK Potentiometer with electric contact or proportional control for *every* temperature process. Every style . . . strip chart, circular scale, circular chart . . . is fully explained and described in new Catalog 15-13. Typical control systems, explanatory tables, and style selection data are included to help you choose the right instrumentation. Send for your copy today and you'll have *the complete story on the complete Brown ElectroniK line.*

MINNEAPOLIS-HONEYWELL REGULATOR CO.
BROWN INSTRUMENTS DIVISION
4464 Wayne Ave., Philadelphia 44, Pa.
Offices in principal cities of the United States, Canada and throughout the world

BROWN *Advanced Instrumentation* FOR METAL WORKING

Product of MINNEAPOLIS Honeywell



Actual tests on SAE 4150 steel show the operator of a Bonnot Billeteer chips 49 times faster than a man with a chipping hammer.

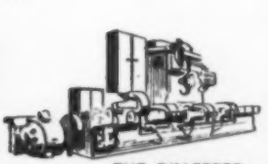
The smooth, steady operation of the Billeteer maintains a flow of clean billets ready for rolling. You can depend on the Billeteer, and large inventories are not necessary. Flaws one inch or more in depth are quickly cut out, salvaging steel that would have to be remelted in plants not equipped with this modern machine.

Bonnot Billeteers replace one of the most gruelling manual chores left in steel production, and do so at overall costs up to 50-60% under hand chipping costs.

Why not lick the manpower problem in your billet sheds by putting Bonnot Billeteers on your payroll? Complete information is furnished on request.

Engineered for Improved Production

The Bonnot Co.
STEEL EQUIPMENT DIVISION
CANTON 2, OHIO



THE BILLETEER

An Important Announcement

TO PRODUCERS OF STEEL

FURNACE ENGINEERS, INC., nationally noted for the design, construction and installation of all types of heating and heat treating furnaces, has now expanded its staff and facilities to include designing, construction and rebuilding of open hearth furnaces.

The engineers who will conduct this phase of F.E.I. business have a wide background of experience in the construction and operation of open hearth furnaces. They are prepared to handle the entire job, from original determination of needs through design and construction to successful operation.

The F.E.I. trademark on any piece of equipment is your guarantee of accuracy, dependability and efficiency in performance.

We will be very glad to consult with you on your needs without obligation to you. Just write or call.

F.E.I.

FURNACE ENGINEERS, INC.
1552 WEST LIBERTY AVENUE PITTSBURGH, PA.

F.E.I. *builds*

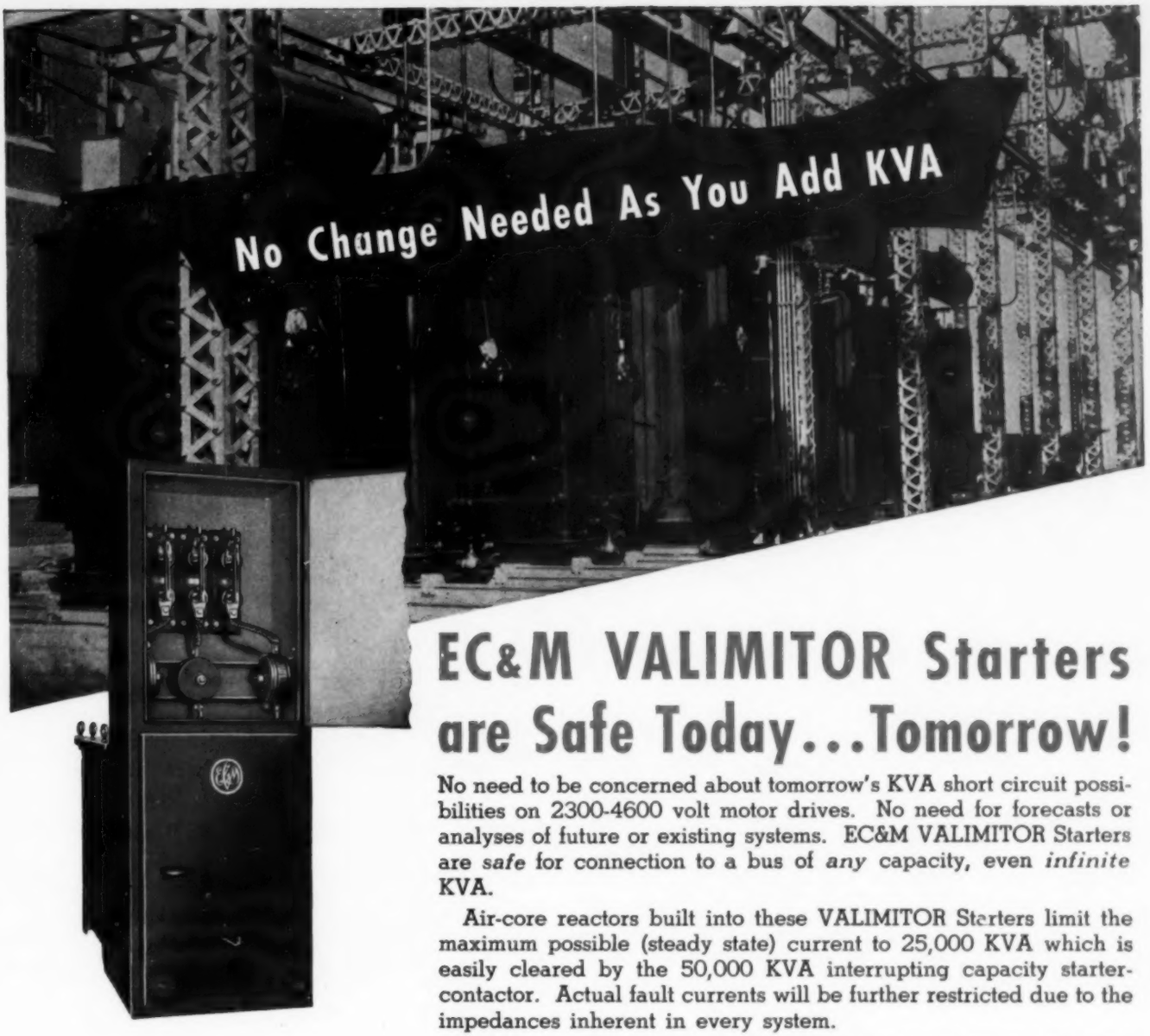
OPEN HEARTH FURNACES

CONTINUOUS BLOOM, BILLET and SLAB HEATING FURNACES

DIRECT FIRED COVER FURNACES
for sheet and coil annealing

SALT DESCALING FURNACES
for stainless steel sheet, bar and other products

GALVANIZING FURNACES
for tubes, sheet and metalware



EC&M VALIMITOR Starters are Safe Today...Tomorrow!

No need to be concerned about tomorrow's KVA short circuit possibilities on 2300-4600 volt motor drives. No need for forecasts or analyses of future or existing systems. EC&M VALIMITOR Starters are *safe* for connection to a bus of *any* capacity, even *infinite* KVA.

Air-core reactors built into these VALIMITOR Starters limit the maximum possible (steady state) current to 25,000 KVA which is easily cleared by the 50,000 KVA interrupting capacity starter-contactor. Actual fault currents will be further restricted due to the impedances inherent in every system.

When a fault occurs, there's *nothing to replace*. And the thermal effects and electro-magnetic forces clear back to the power source are limited to safe values by EC&M VALIMITOR Starters. For a *permanent* solution, simply tell us the motor characteristics (HP, voltage, phase and frequency) and type of motor.

VALIMITOR STARTERS give *Complete* Protection.

MAXIMUM RATINGS

for squirrel-cage, synchronous or wound rotor motors

2300 volts		4600 volts
600 HP	60 cycles	600 HP
300 HP	25 cycles	250 HP

SHORT CIRCUIT Protection —Fault currents limited to 25,000 KVA (steady state) current on *any* system. EC&M Type ZHS Contactors (50,000 KVA interrupting capacity) clear such faults easily.

OVERLOAD Protection —Magnetic Overload Relays protect against failure to start, single phase operation and sustained overloads when the motor is operating—Trip instantly on fault currents.

LOW VOLTAGE Protection is normally provided by a momentary-contact start push button. Time-delay low voltage protection can be supplied where line voltage dips momentarily. Starters can also be arranged for low voltage release. Automatic or magnetic re-set of overload relays is supplied as needed to meet these conditions.

CUSHIONED STARTING—Full Voltage VALIMITOR Motor Starters inherently provide a degree of reduced voltage starting without the use of additional equipment. In many instances, the full voltage starter will save the cost of the more expensive reduced-voltage type of VALIMITOR Starter. After the initial starting period is over, motor voltage automatically recovers to substantially normal line voltage.

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET ★ CLEVELAND 4, OHIO

Modern Blooming-Slabbing Mill Uses amplidyne-controlled TWIN DRIVES

Higher reversal and average speeds, larger tonnages made possible by amplidyne control of acceleration, deceleration, torque balance, and speed

In a large steel mill west of the Mississippi, one big reason for the 45-in. blooming-slabbing mill's high output is the G-E twin-motor reversing drive. Keyed to an adjustable-voltage amplidyne control system, this drive gives the operator an improved method of maintaining voltage for any given operating point, permits the higher average speeds that increase mill production. It also gives these specific advantages:

—**Provides** accurate control of acceleration and deceleration, maintaining maximum rates at all times. After running in one direction for a few revolutions, the mill can be quickly reversed (from base speed to base speed in 1½ seconds or less).

—**Assures** effective control of load limits, making maximum torque output of motors available as needed, for heavy passes at low speed and lighter passes at higher speed.

—**Reduces** the number of control devices required by about half, greatly simplifying the control scheme.

—**Maintains** accurate load balance between two or more machines operating in parallel, and proper torque and speed balance on both units of the twin-drive.

—**Keeps** motors and generators fully protected at all times against overcurrent, overvoltage, and overspeed for greater service continuity, longer equipment life.

—**Provides** definite, easily-selected speed points in both forward and reverse; permits low creeping speed to keep rolls turning slowly between passes for uniform cooling; eliminates creeping when necessary to line up couplings for changing rolls.

Whether you plan to install a new reversing-mill drive or modernize an existing one, General Electric can meet your need for higher speed and more accurate control. Call in a G-E steel mill engineer to talk it over. There's no obligation. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

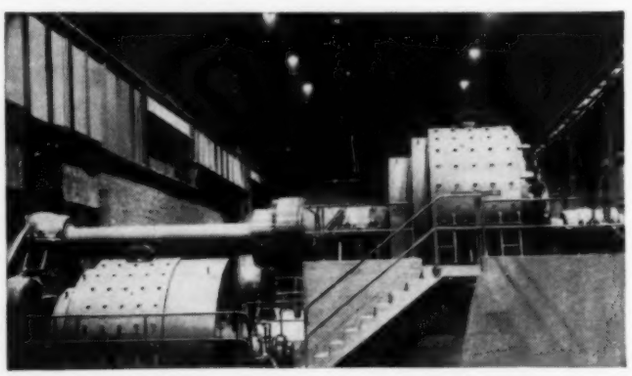
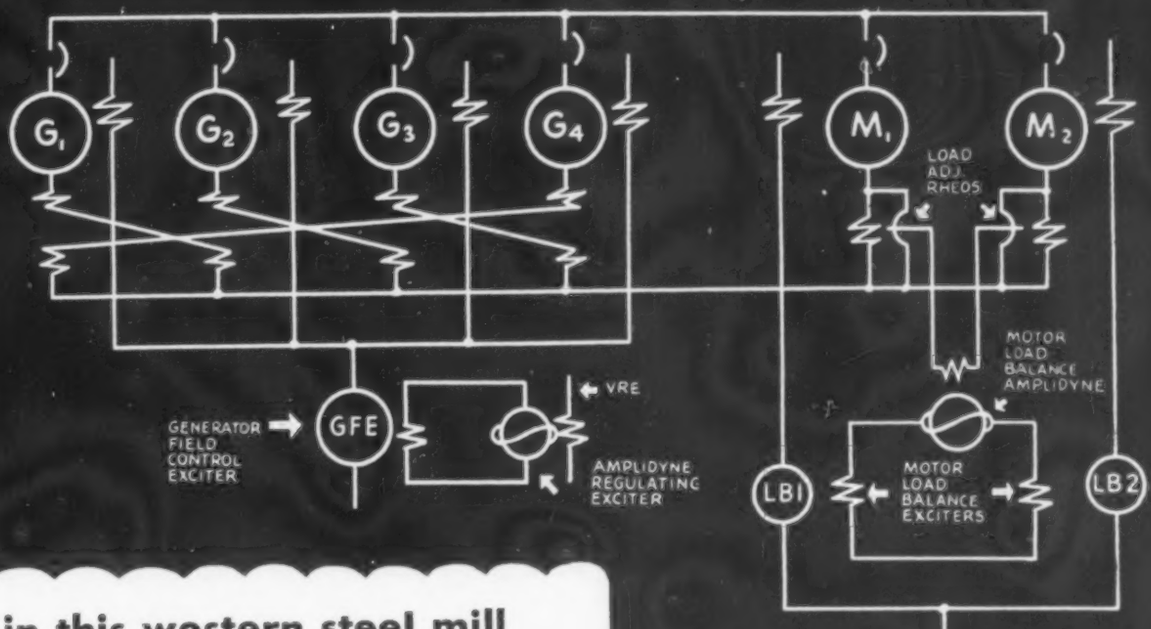


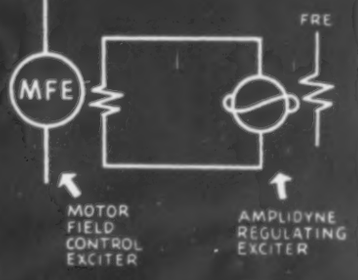
Photo shows the G-E twin-drive motors used in a 45" x 115" reversing slabbing mill. Each d-c motor is 5000 hp, 40/80 rpm, 750 volts.

GENERAL ELECTRIC

659-82

HOW THE G-E DRIVE WORKS . . .





Schematic plan of armature and field circuits for G-E twin-motor slabbing mill drive.

. . . in this western steel mill

The speed of the twin motors (M_1 and M_2) is varied by adjusting the voltage of the generators ($G_{1,2,3,4}$) from zero to full voltage for either direction of rotation. This is done by means of the generator field exciter (GFE) and the amplidyne regulating exciter (VRE). For higher speeds the fields of the motors are weakened by means of the motor field exciter (MFE) and the amplidyne regulating exciter (FRE).

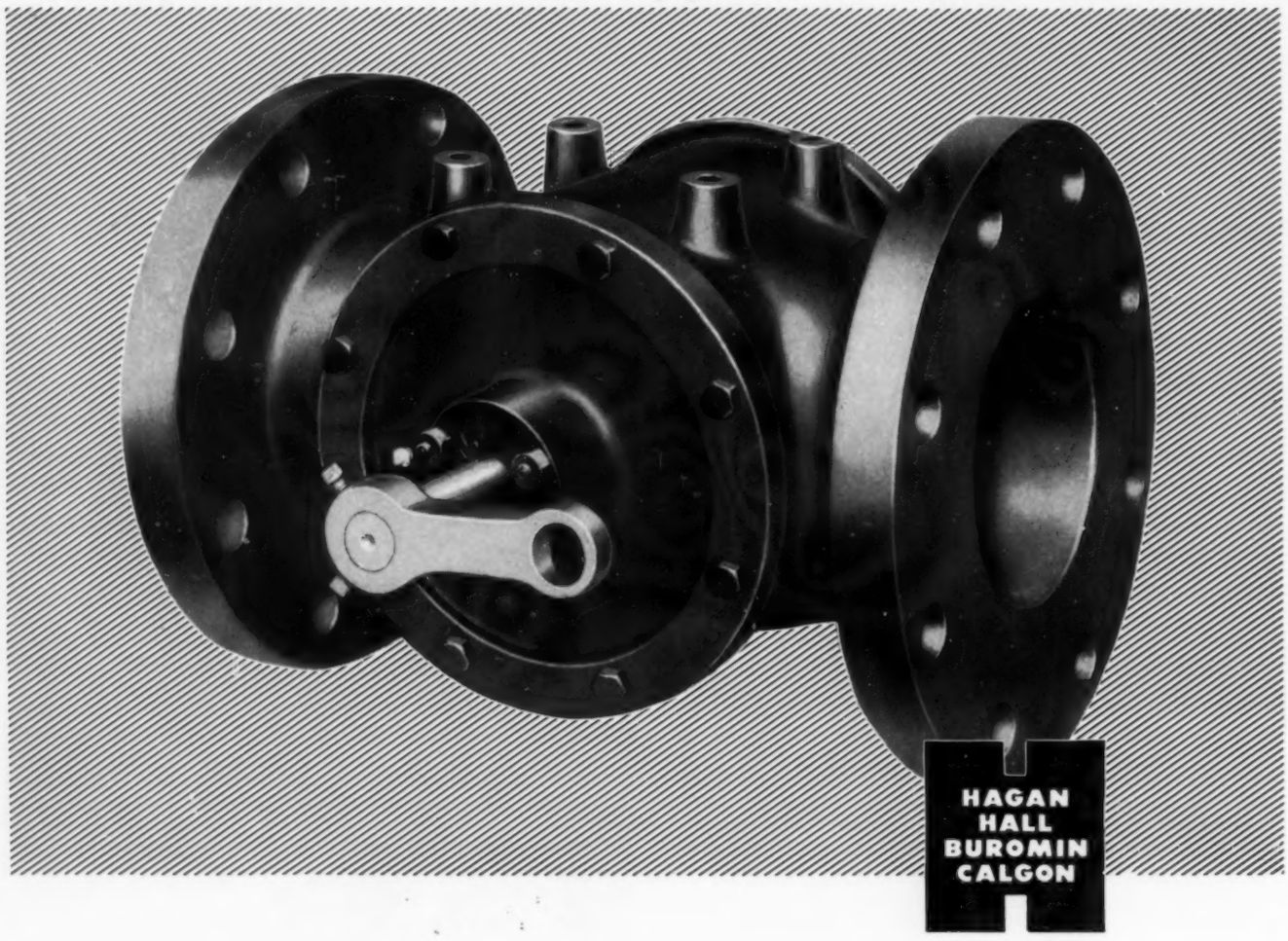
The regulating exciters (VRE and FRE) cause the twin motors (M_1 and M_2) and the mill to operate in a direction and at a speed determined by the position of the operator's master switch. In doing so, these amplidynes automatically limit the armature circuit current to a definite value. If, when operating with weakened motor fields, the operator tries to take an excessive draft, the amplidyne (FRE) acts to limit armature current. This it does by strengthening the motor fields, thereby supplying increased torque at lower speed.

Motor M_1 drives the upper work roll. Motor M_2 drives the lower work roll. Motor load balance amplidyne (LB) measures the difference between the two motor load currents. Amplidyne (LB) supplies excitation to the motor load balance exciters (LB_1 and LB_2) so as to strengthen the field of the motor carrying the higher load and weaken the field of the motor carrying the lower load. This restores the load current balance.

another example of

drive engineering at work!

The Hagan V-Port Butterfly Valve



gives smooth, accurate regulation over the entire range of operation

Accurate proportioning of fuel and air is essential in the modern furnace, where heat input may vary over a turn-down range of 10 to 1. The need is particularly great at the low rates because at this time steel is up to temperature and most sensitive to furnace atmosphere.

At a minimum flow, the differential across regulating valves is usually the greatest. Losses across the measuring orifice, duct work and burner decrease, so that loss across the regulating butterfly must increase by a corresponding amount.

In the Hagan V-Port Butterfly Valve all of these factors are taken into account in port design, and smooth, accurate regulation is secured over the entire range of operation.

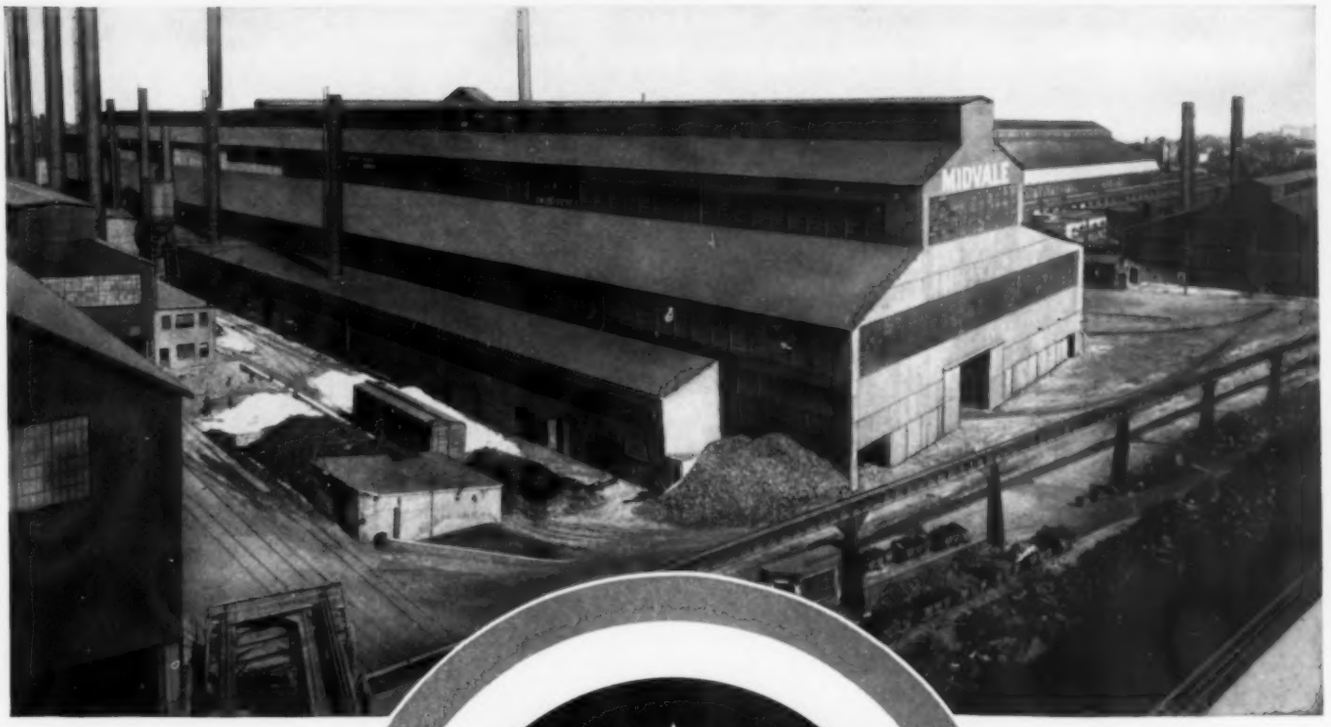
The shape of the ports in this valve is such that full advantage is taken of the inherent sensitivity and accuracy of regulating equipment.

Hagan V-Port Butterfly Valves are made in standard pipe sizes. They are ruggedly built and accurately machined. Our engineers will be glad to give you full information.

Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES



SYMBOL OF THE FINEST

in quality steel making — the Midvale M-Star

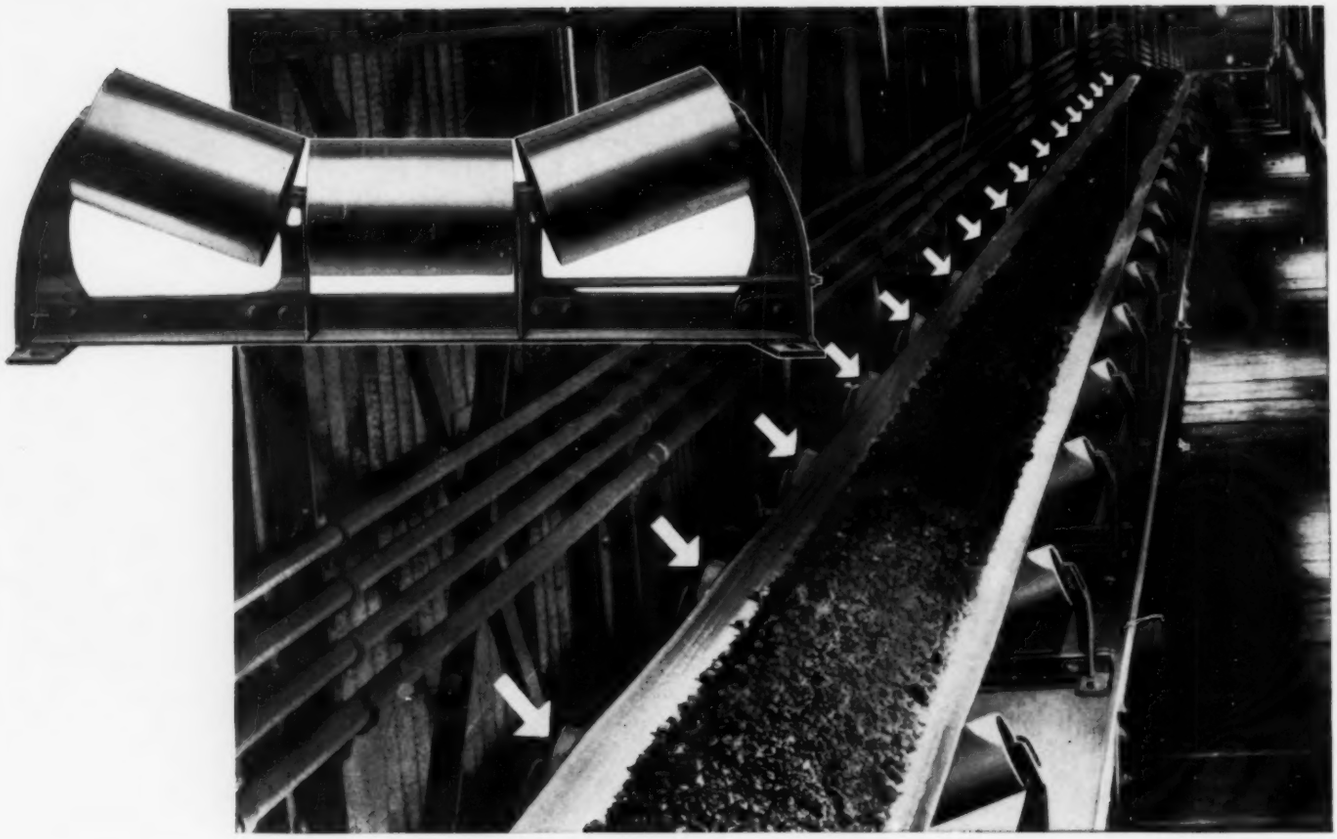
For 81 years Midvale has been manufacturing many steel products for a wide range of use. The outstanding performance of these products has earned us an enviable reputation. We look forward to continuing improvement in the manufacture of high quality forgings and high alloy castings to maintain this reputation.

FORGINGS—FORGED, HARDENED AND GROUND ROLLS
WELDLESS RINGS—CORROSION AND HEAT RESISTING CASTINGS

THE MIDVALE COMPANY

NICETOWN • PHILADELPHIA

OFFICES: NEW YORK • CHICAGO • PITTSBURGH • WASHINGTON • CLEVELAND • SAN FRANCISCO



Link-Belt Standardized Design Cuts Belt Conveying Costs

In the Link-Belt "100" series belt conveyor idlers, we believe that we have achieved the ultimate in design and performance, with evolution of engineering features progressively since 1896. These features cut conveying costs by reducing maintenance, giving longer service, and permitting the greatest simplification.

In addition to idlers, Link-Belt builds a great variety of standardized design conveyor elements and accessories such as: belt and apron feeders for uniform loading; trippers for intermediate discharge or distribution; drives using gears, reducers and chains; terminal machinery; supporting structures and enclosures.

We are at your service for complete conveyor systems, or individual equipment, to suit your requirements.

LINK-BELT COMPANY

Chicago 9, Philadelphia 40, Pittsburgh 13, Wilkes-Barre, Huntington, W. Va., Atlanta, Dallas 1, Minneapolis 5, Denver 2, Kansas City 6, Mo., Los Angeles 33, San Francisco 24, Cleveland 13, Indianapolis 6, Detroit 4, St. Louis 1, Seattle 4, Vancouver, Toronto 8.

11.213

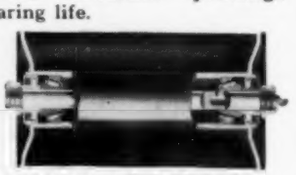
LINK-BELT

THE SYMBOL OF QUALITY

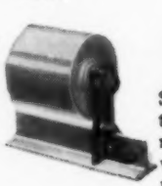
BELT CONVEYOR EQUIPMENT

IDLERS • TRIPPERS • BELTS • PULLEYS • BEARINGS • DRIVES

Grease-in—Dirt-out Seal
prevents harmful foreign matter from reaching bearings — conserves lubricant — prolongs bearing life.



Rolls
made with smooth rounded-edge outer shell of uniform thickness, and a full-length steel central tube, both continuous-welded to dished steel heads to form sturdy, well-balanced integral units.



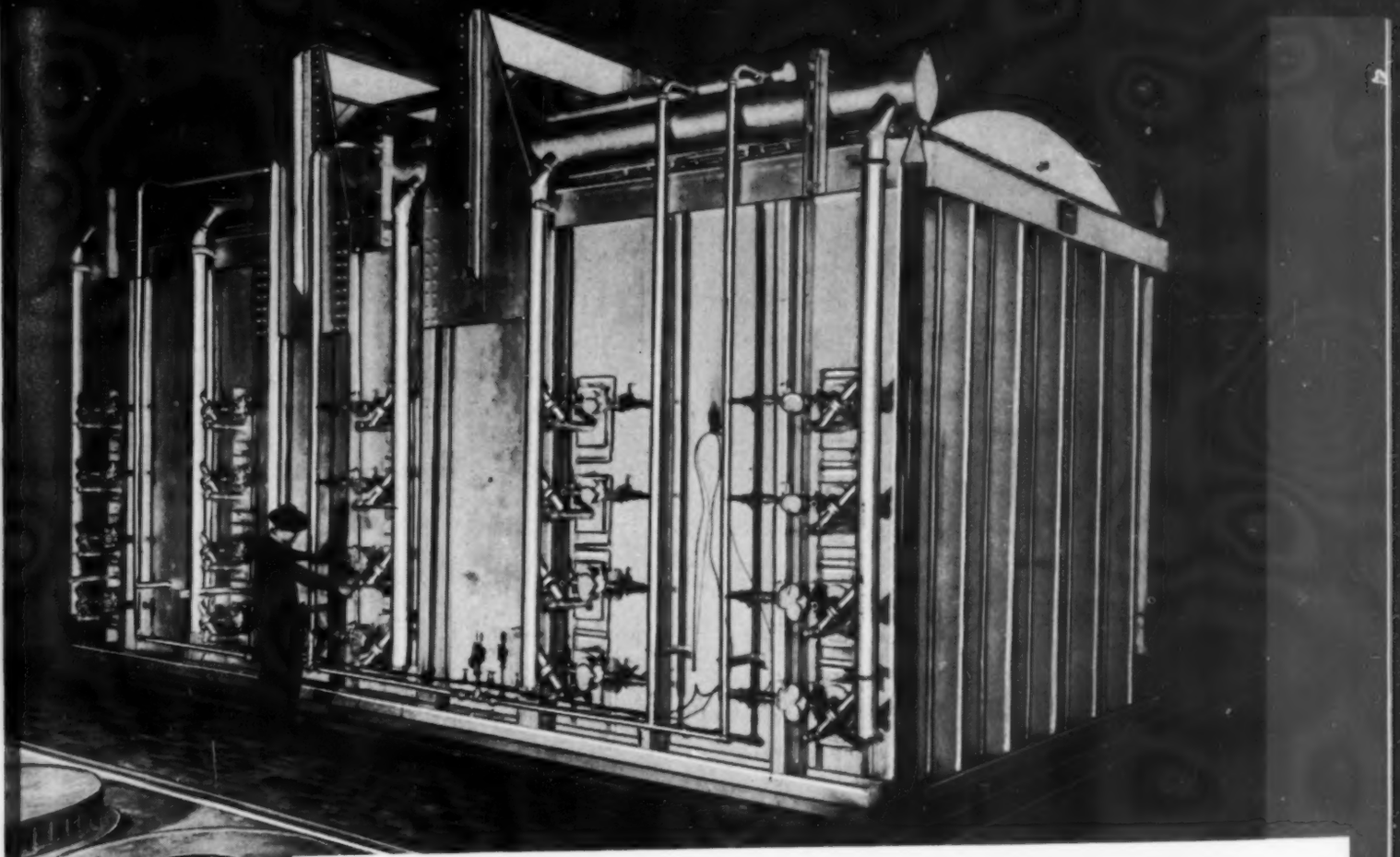
Strong Brackets Support the Rolls

Supporting brackets are tough malleable iron in reinforced T-section to withstand load and impact.

Interlocking Nuts and Yokes Prevent Brackets from Spreading

Impact Idlers with Rubber Treads

Interchangeable with steel rolls this type provides a Cushion at loading points to protect idlers and preserve the belt — A good investment where heavy lump materials are handled.



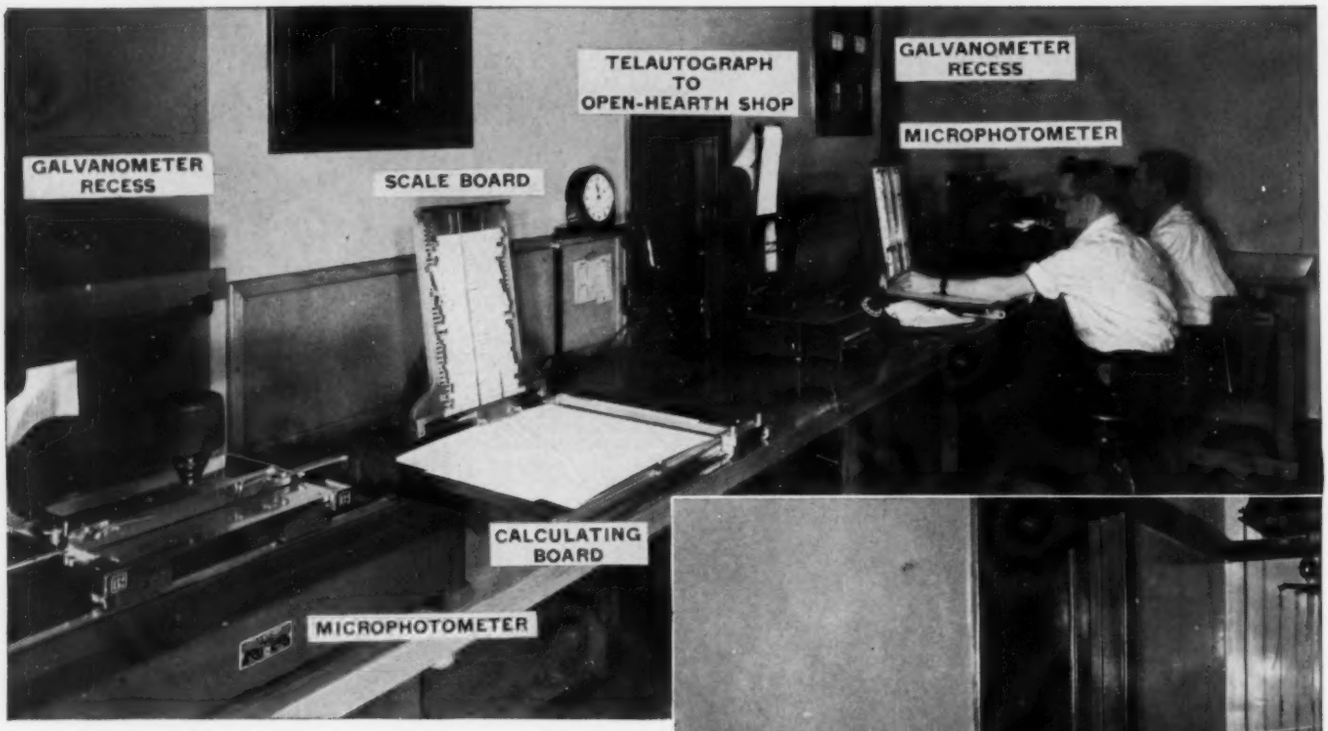
SWINDELL-DRESSLER

a recent high-capacity furnace installation for a large strip mill.

MAY WE HAVE YOUR INQUIRIES?

SWINDELL-DRESSLER CORPORATION
PITTSBURGH 30, PENNA.

Designers and Builders of Modern Industrial Furnaces



Above, Room containing Vincent-Sawyer Microphotometers in a steel mill's spectrochemical control laboratory. Here five men handle the control and heat analyses for the open-hearths and electric furnaces. The other three men on the shift stepped out of this picture so we could show the microphotometer at the left.

Steel Analyzed in Minutes With New Microphotometer

An average of 15 minutes from the time a sample is received until the composition has been reported — that is the speed of routine analyses in an Eastern steel mill.

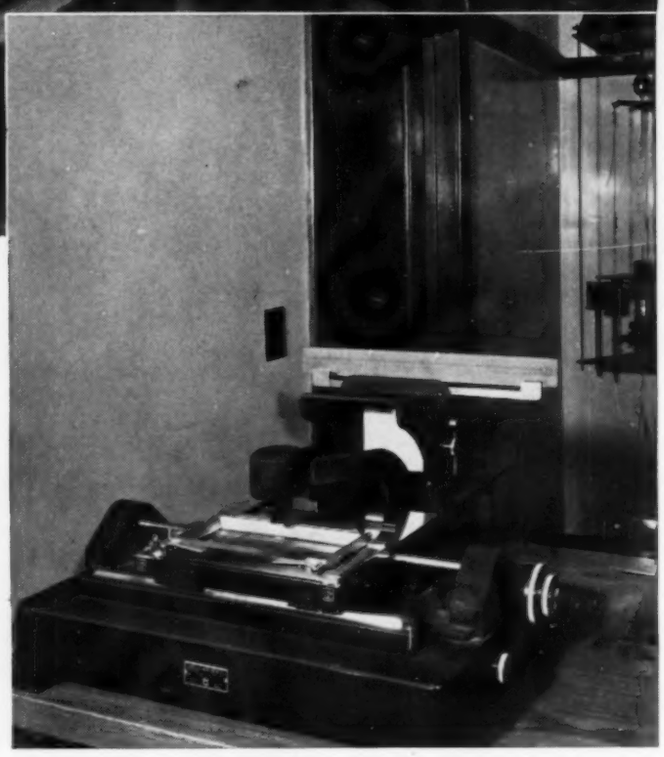
This extra-fast analysis, accomplished with the L&N Vincent-Sawyer Microphotometer, enables open-hearth and electric furnace helpers to bring the analysis of each melt closely to specifications; cuts the total time per heat.

Samples from electric furnaces and open-hearths are sped by pneumatic tube to the laboratory, where exposures (spark or arc as required) are taken, developed and sent to the microphotometer room. An operator next measures densities of preselected spectrum lines with the microphotometer. Another operator translates density ratios into percentages of elements, and the foreman then examines the analysis and sends it by Telautograph to the open-hearth shop.

Designed for rapid, routine analyses rather than for research, the L&N Vincent-Sawyer Microphotometer has the following advantages in addition to speed:

1. Exceptional accuracy and stability. Positioning of the spectrum plate is rapid and highly precise. Photoelectric scanning is sharp and accurate. Indicator is an L&N Type HS Galvanometer whose high sensitivity makes an amplifier unnecessary; readings are free from pick-up.

2. Easy and simple to use. Operation requires only a few simple, natural motions and a minimum of eye movement — important factors in reducing fatigue and error.



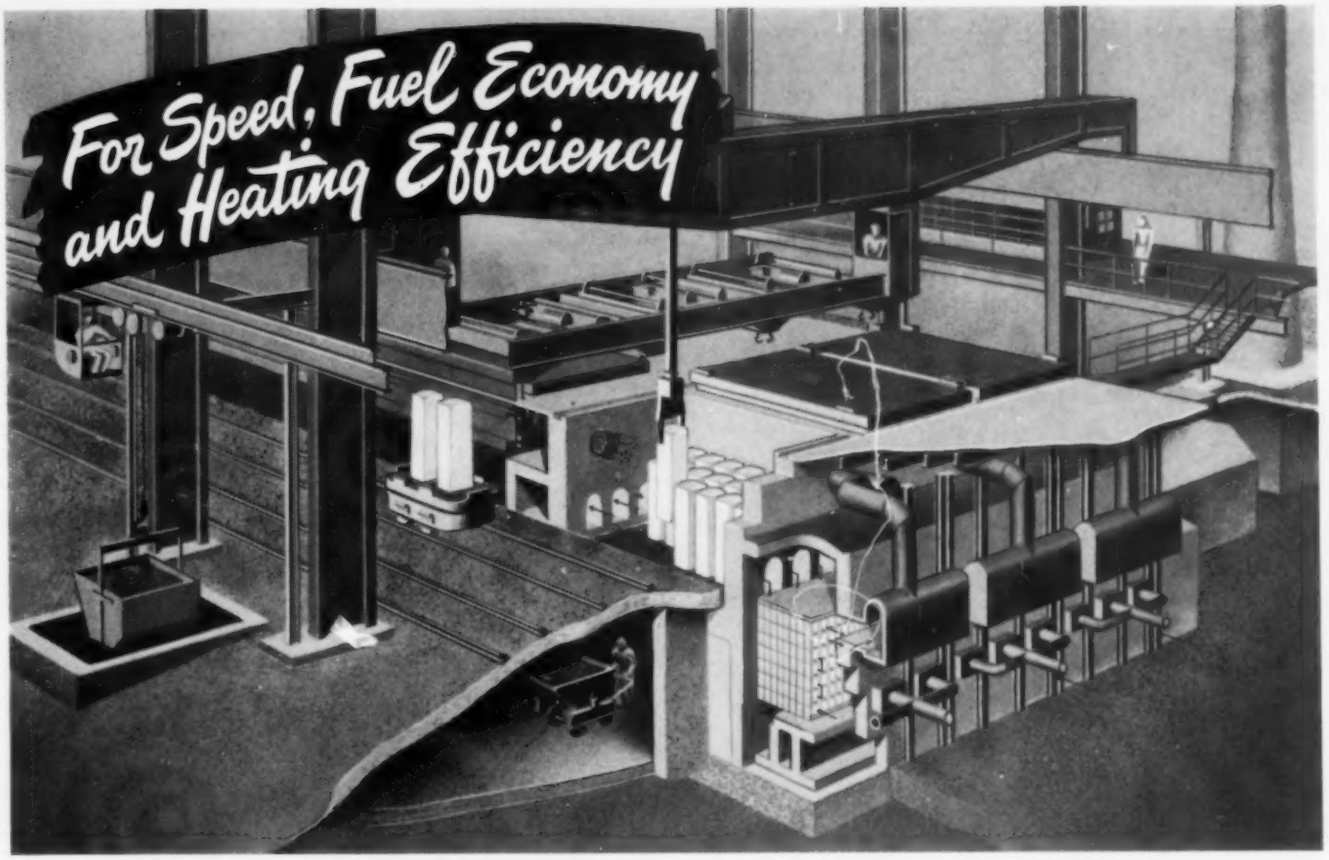
Close-up view of Microphotometer and galvanometer assembly.

The instrument is described in detail in an 8-page folder which we'll be glad to send on request. Ask for Reprint F-90(1). Leeds & Northrup Company, 4942 Stenton Ave., Philadelphia 44, Pa.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

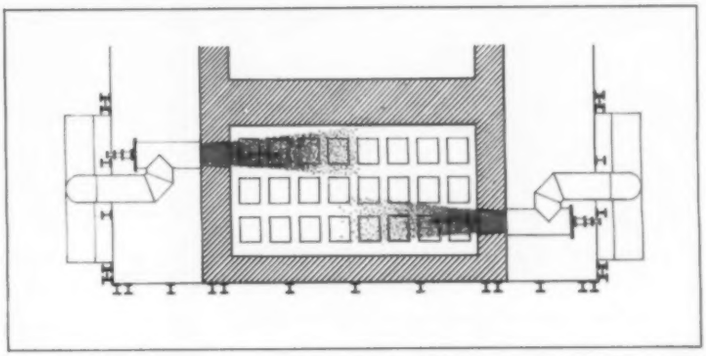
Jrl. Ad E-90(4)

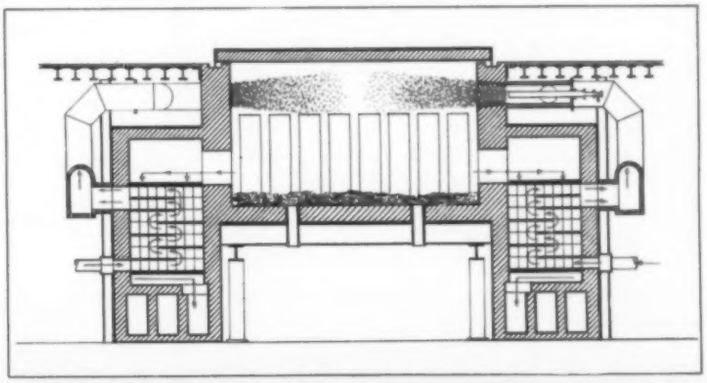


RUST CONTINUOUS-FIRED SOAKING PITS

Two-way top fired ▲ Completely automatic ▲ Recuperative type ▲ All fuels

THESE ULTRA MODERN SOAKING PITS provide increased efficiency, increased economy and greater charging capacity per sq. ft. of area. By diagonal two-way firing the heat is distributed uniformly throughout the pit and on cut backs both ends of the pit remain in balance thus ingots soak out evenly. Absence of impingement increases life of refractory walls and covers. Design permits construction in batteries of two or more holes.





THE WHOLE JOB IS ONE JOB WITH A "RUST PACKAGE CONTRACT"

ONE RUST CONTRACT covers everything . . . from blueprint to test-run. Rust assumes responsibility for design, manufacture and erection of all essential material . . . including excavations, foundations, wiring and piping. Your purchasing and engineering departments are freed of subcontractor headaches when you order from Rust.

RUST FURNACE CO.

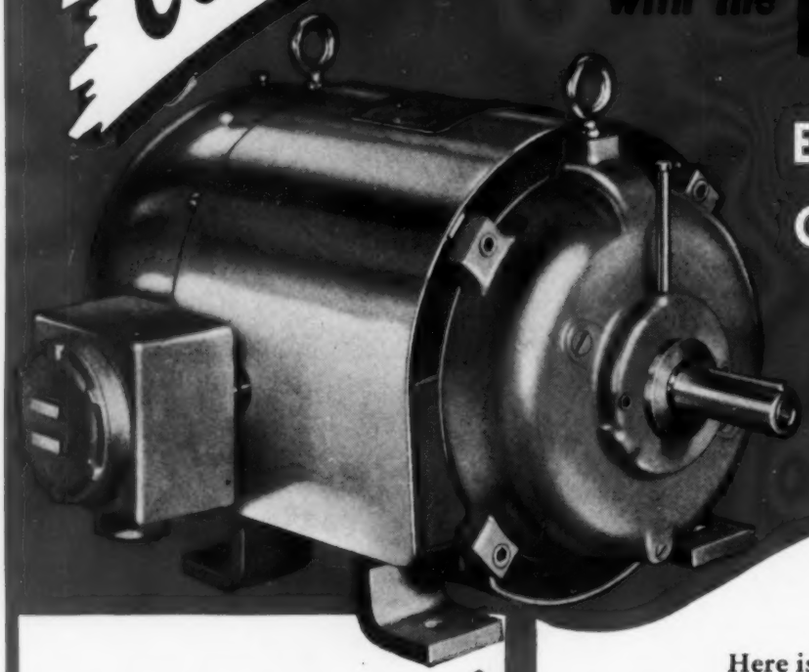
PIONEERS IN FURNACE DESIGN

PITTSBURGH, PENNSYLVANIA

COMPLETE INSURANCE

with the **RELIANCE**

EXPLOSION-PROOF and CORROSION-RESISTING MOTOR



Selected Materials and Design Features

OFFER MAXIMUM PROTECTION!

FOR CORROSIVE ATMOSPHERES

The Totally-Enclosed Fan Cooled A-c. Motor for Applications where Chemical Atmospheres Prevail

and

FOR ATMOSPHERES CONTAINING HAZARDOUS GAS OR INFLAMMABLE LIQUIDS

Underwriters' Class 1, Group D Explosion-Proof A-C. Motor

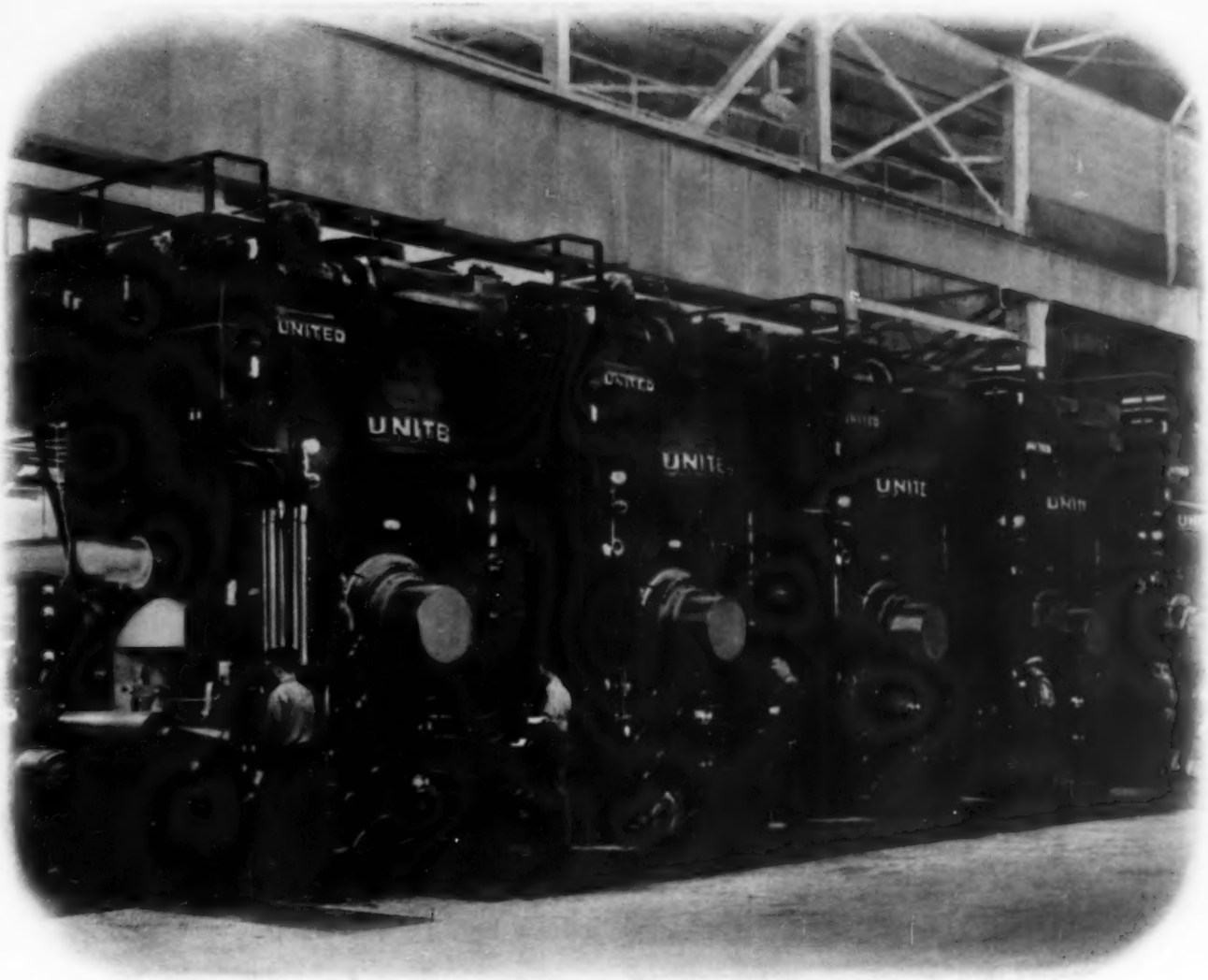
Here is the result of Reliance engineering applied to the problem of protecting motors that operate in either corrosive or explosive atmospheres. Frame and fan covers, fan, conduit box and end brackets are all made of selected corrosion-resisting materials. In addition, many extra steps are taken to achieve maximum protection, such as coating screws, counterboring screw holes and fitting-up with special compounds.

Reliance *Precision-Built* Motors offer you the *right* motor for any application. For further information about this explosion-proof, corrosion-resisting motor, write for Bulletin C-130.

***Sales Representatives** in Principal Cities*

RELIANCE ELECTRIC AND ENGINEERING CO.

1084 IVANHOE ROAD • CLEVELAND 10, OHIO



5 Stand — 4 High Tandem Cold Mill

Sheet and tinplate for cans, automobile bodies, household appliances and other metal products are rolled on United mills of this type at speeds up to a-mile-a-minute.

Designed and built by

UNITED ENGINEERING AND FOUNDRY COMPANY

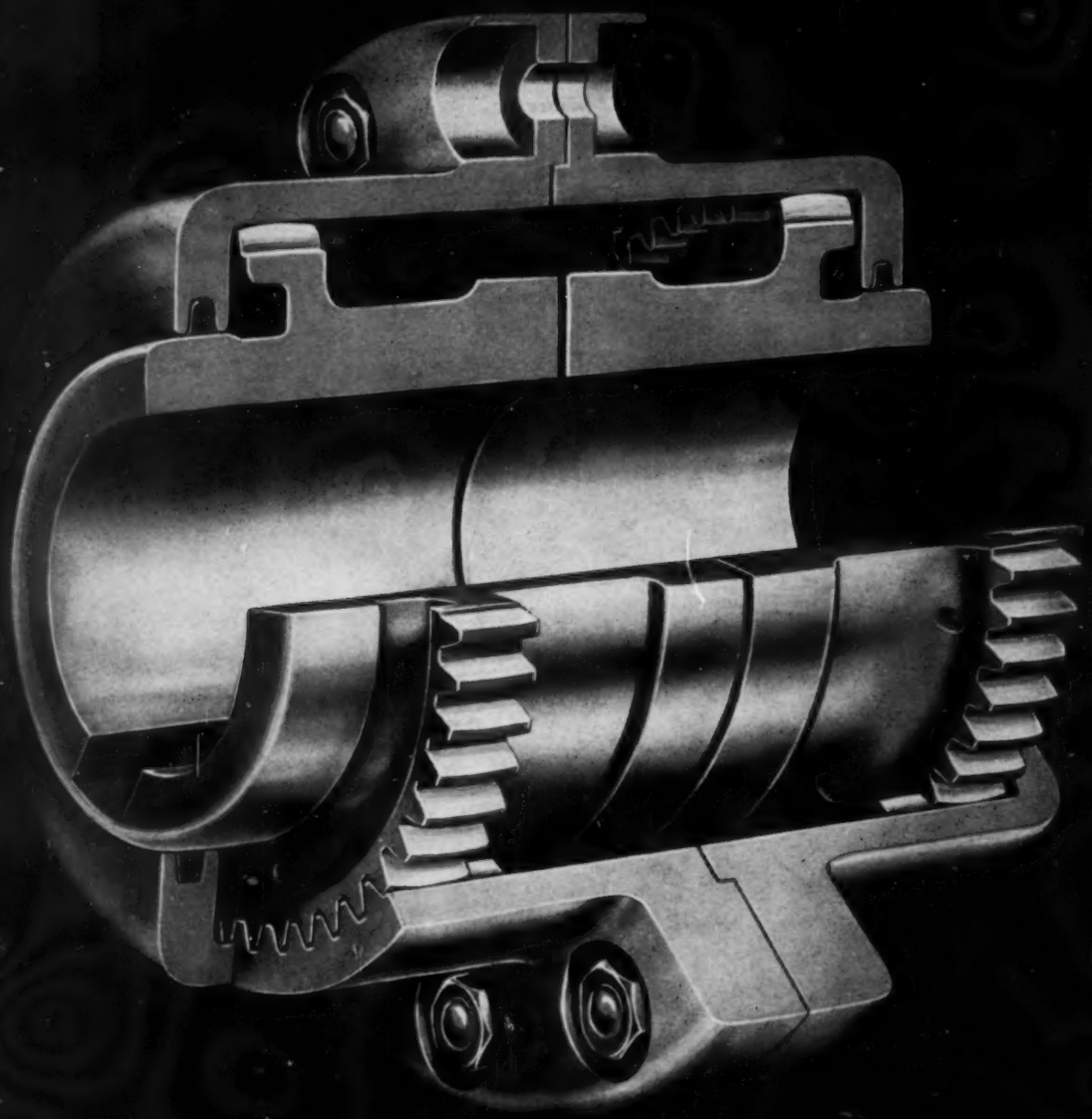
Pittsburgh, Pennsylvania

Plants at Pittsburgh—Vandergrift—New Castle—Youngstown—Canton
Subsidiary: Adamson United Company, Akron, Ohio
Affiliates:
Davy and United Engineering Company, Ltd., Sheffield, England
Dominion Engineering Works, Ltd., Montreal, P. Q. Canada
S. E. C. I. M., Paris, France

Designers and Makers of Rolls and Rolling Mill Equipment

DETROIT PUBLIC LIBRARY

POOLE



A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

POOLE FOUNDRY & MACHINE COMPANY

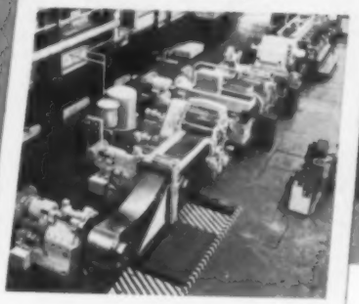
WOODBERRY, BALTIMORE, MD.

The WEAN ENGINEERING Company, Inc.

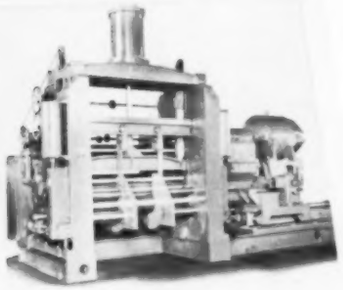
WARREN, OHIO

Continuous Strip Pickle Line

Continuous Coating Line



Processing Uncoiler



Associated Companies

WEAN EQUIPMENT CORPORATION
Cleveland, Ohio

WEAN MANUFACTURING CO.
Warren, Ohio

THE McKAY MACHINE COMPANY
Youngstown, Ohio

FLINN & DREFFEIN ENGINEERING COMPANY
Chicago, Illinois

THE HALLDEN MACHINE COMPANY
Thomaston, Connecticut

THE DREVER COMPANY
Philadelphia, Pennsylvania

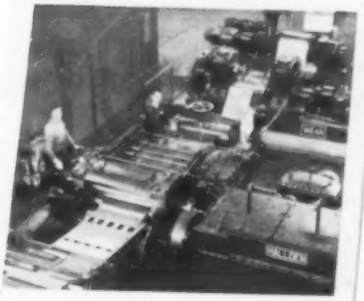
THE WEAN ENGINEERING CO. OF CANADA, LTD.
Hamilton, Ontario

REPRESENTATIVES

England—
JOHN MILES & PARTNER
(London, Ltd.)
London, England

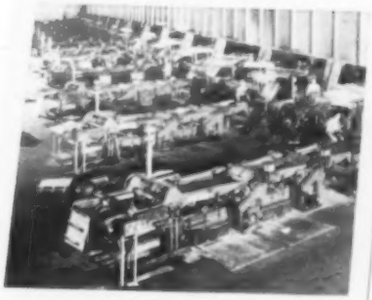
France—
DOCUMENTATION & LICENSES
Paris, France

Tin Plate Shearing Line



Continuous Electrolytic Cleaning Line

Hot-Dip Tinning Units

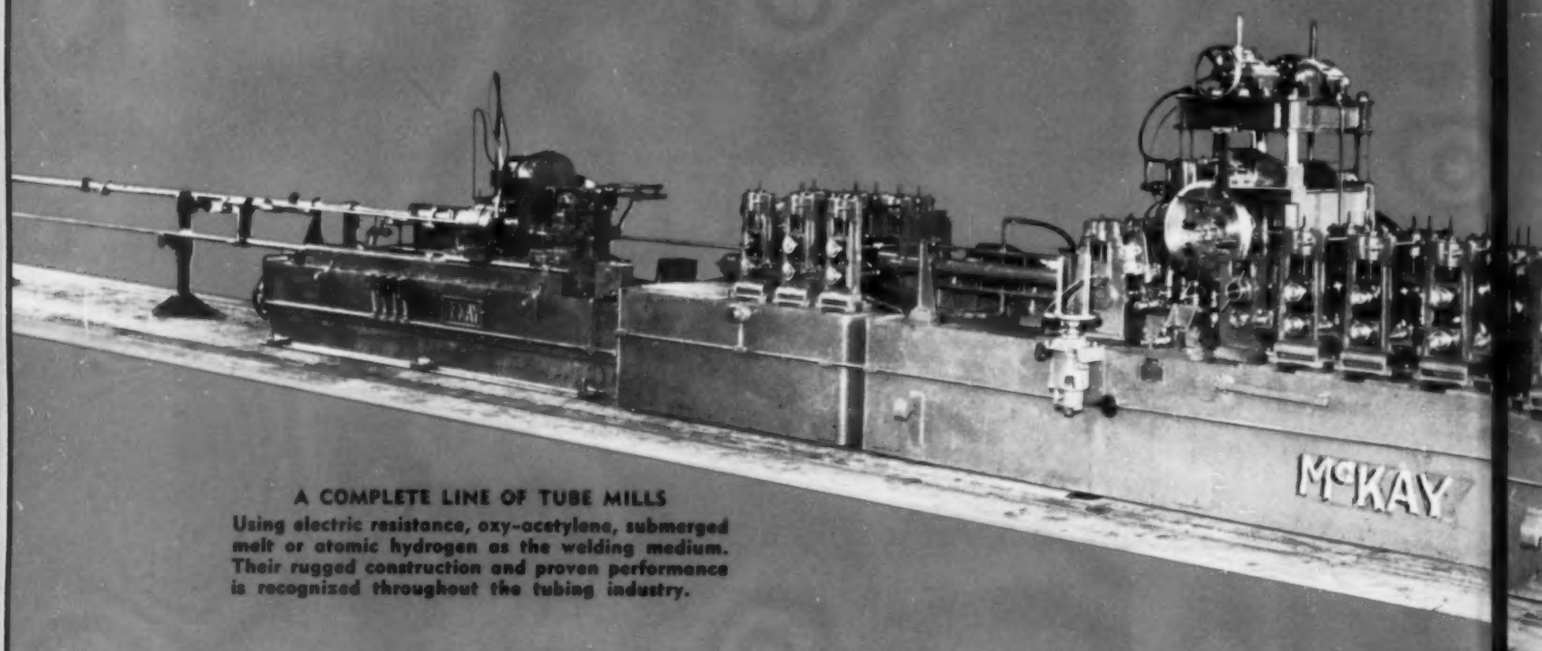


Continuous Hot-Dip Galvanizing Line

Mechanized Sheet Mill

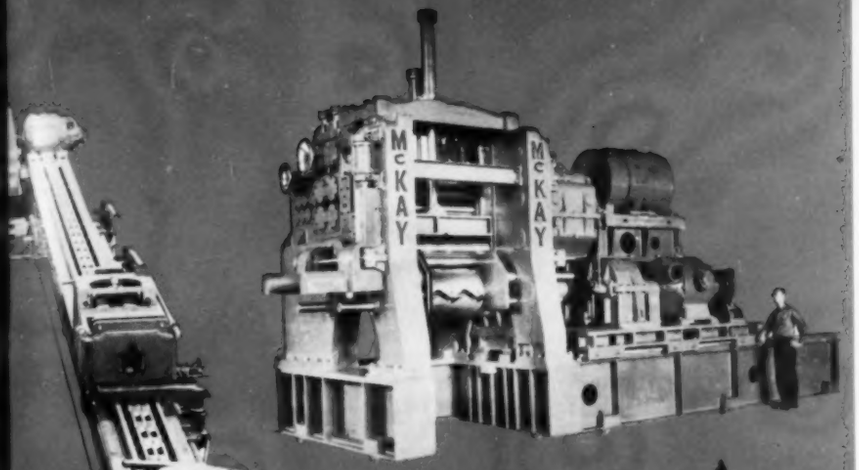
SPECIALISTS IN SHEET, TIN & STRIP MILL EQUIPMENT

McKAY

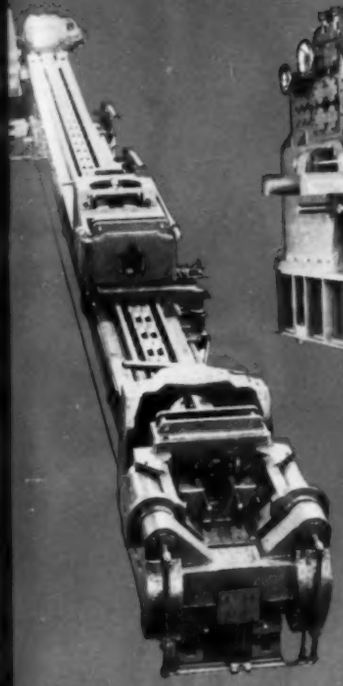


A COMPLETE LINE OF TUBE MILLS

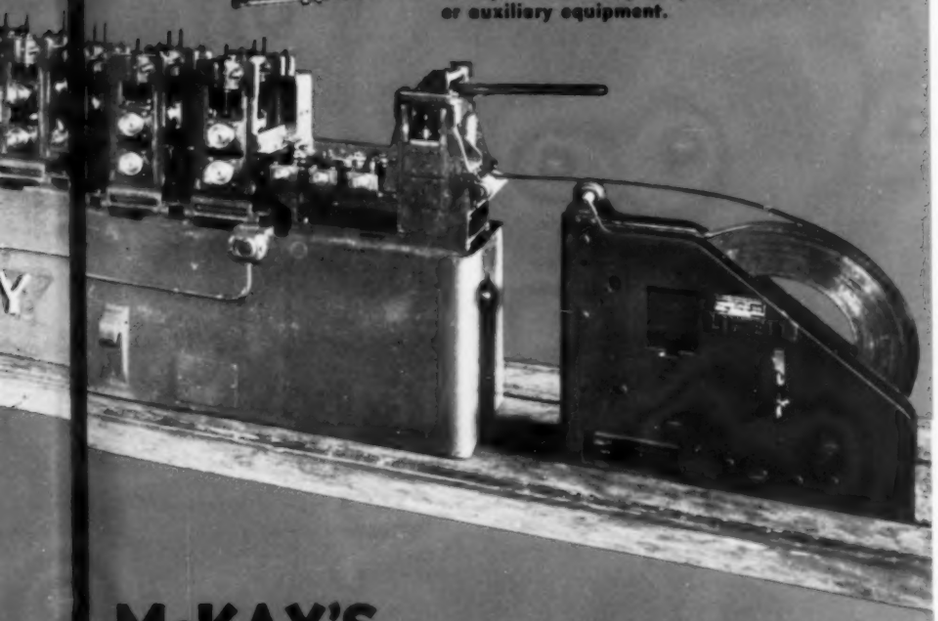
Using electric resistance, oxy-acetylene, submerged melt or atomic hydrogen as the welding medium. Their rugged construction and proven performance is recognized throughout the tubing industry.



HEAVY DUTY PROCESSING UNCOILER
Recoginzed as a "MUST" for all steel mill continuous pickling and cut-up installations. New designs provide for uncoiling speeds up to 1600 F.P.M.



SINGLE OR MULTIPLE DRAW BENCHES
For bars and tubes, in a complete range of capacities, with push pointers and other auxiliary equipment.



McKAY'S Progressive Engineering Service to the steel mills, automotive and fabricating industries has been implemented by an up-to-date engineering department and supplemented by improved and enlarged manufacturing facilities.

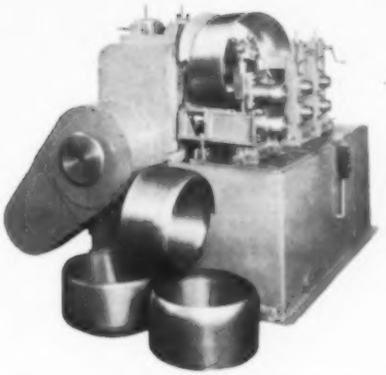
Our principal objective is to design and build equipment to give you greater production at lower cost.

The **McKAY MACHINE** *Company*

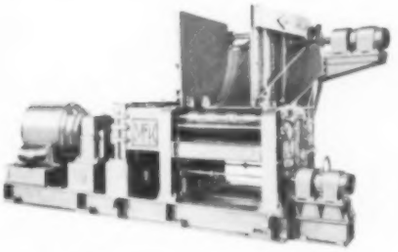
Engineers and Manufacturers of Sheet, Tin, and Strip Mill Equipment

YOUNGSTOWN, OHIO

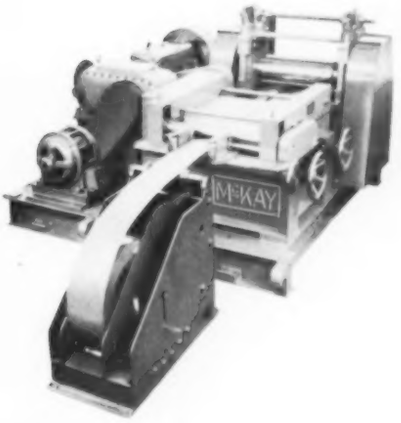
Associated Company The WEAN ENGINEERING CO., Warren, Ohio



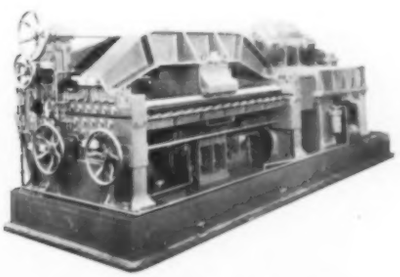
SPECIAL COLD ROLL FORMING EQUIPMENT
Designed and built in a complete range of sizes to meet customer's requirements.



AN ENTIRELY NEW UNCOILER
Designed for rolling mill service with many important new features.



AUTOMATIC CUT TO LENGTH UNIT
Composed of roller leveler and rotary shear—for coiled strip 6" to 36" wide. A sure bet to reduce floor space and handling costs.

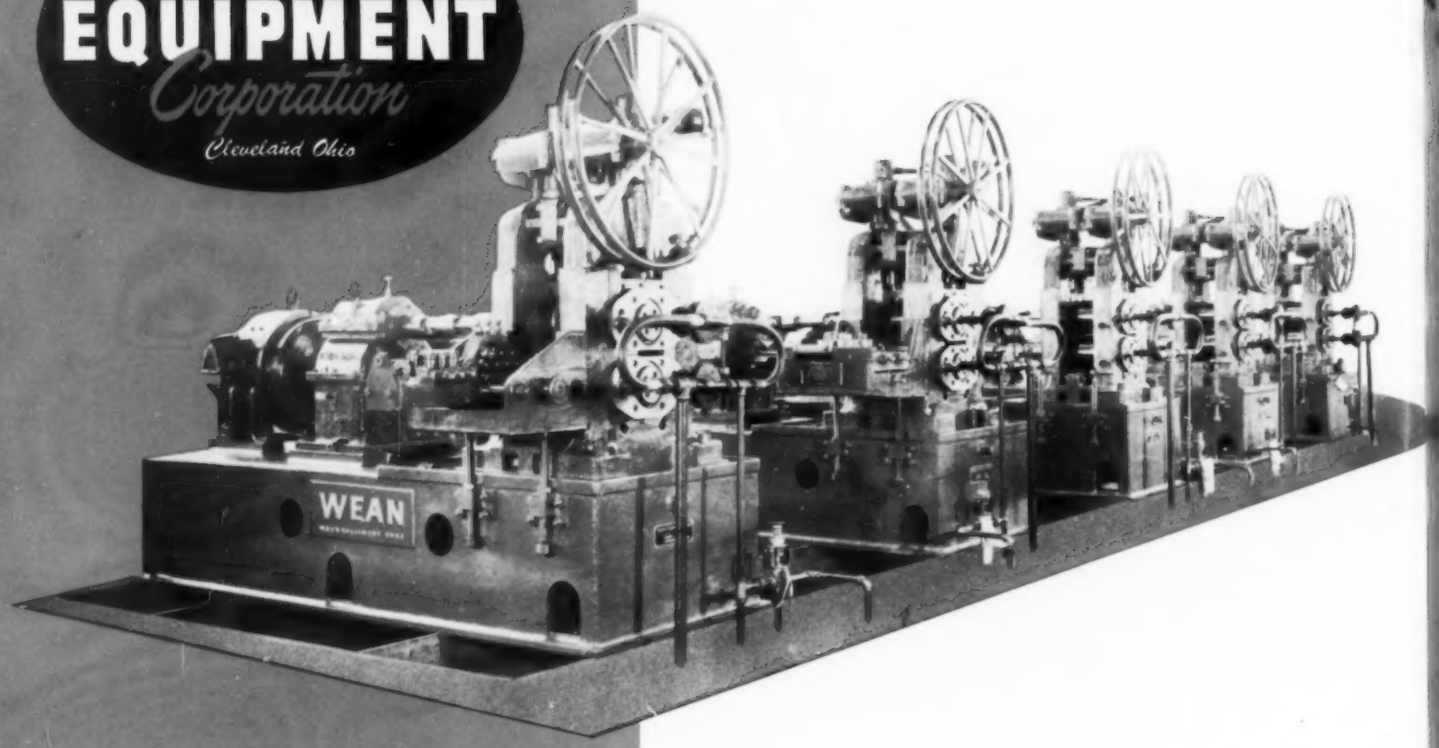


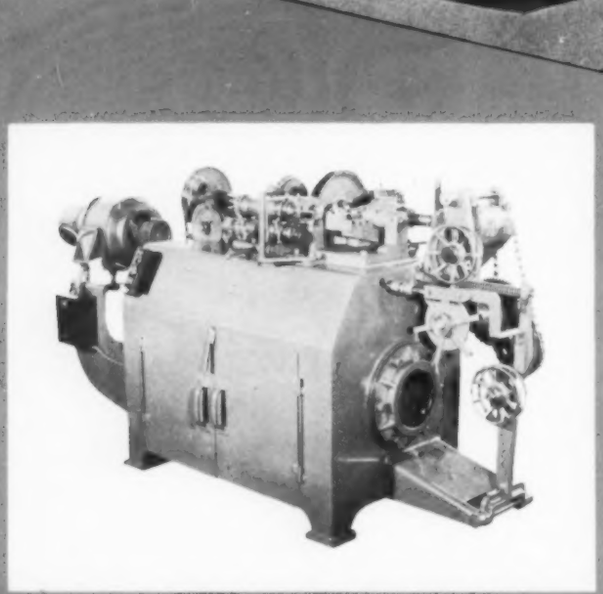
BUDD - McKAY PROCESSORS
Recoginzed as being indispensable for processing sheet metal before die drawing—resulting in strain prevention and minimizing rejects due to breakage.

WEAN EQUIPMENT Corporation

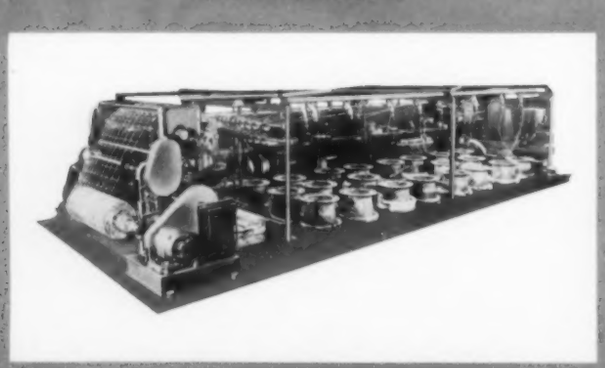
Cleveland Ohio

8-inch Single Strand
Wire Flattening Mill
With Wire Straighteners





Barbed Wire Machine



No. 1155 Field Fence Machine

The WEAN EQUIPMENT CORPORATION is recognized as a specialist in high-efficiency strip and wire mill equipment.

COLD ROLLING MACHINERY

For 36" Wide Material and Narrower

MILLS — REELS — SLITTERS — LEVELERS
COILERS — EDGERS — SCALE BREAKERS
SHEARS — SCRAP BALLERS
CONTINUOUS PICKLING

WIRE MILL EQUIPMENT

PATENTING, GALVANIZING AND TINNING TAKE-UP FRAMES — WIRE FLATTENING MILLS — SPOOLERS
NAIL GALVANIZING AND BLUEING MACHINES
BARBED WIRE AND FIELD FENCE MACHINES

WEAN

EQUIPMENT CORPORATION

CLEVELAND • OHIO

You can depend on

"OPERATIONAL EXPERIENCE"

The design-engineer of rolling mill equipment should know rolling practices and problems from A to Z. It's the *operational experience* Lewis engineers possess that determines the design of Lewis Rolling Mills and related machinery . . . Results—Simplicity, Productivity and Economy of maintenance.

We welcome the opportunity to discuss ways and means of increasing your capacity and profits.

LEWIS MAKES

Beds—Cooling
Blanks—Gear • Pinion
Boxes—Coupling
Castings—Rolling Mill Furnace
Coilers—Ferrous and Non-ferrous Strip
Gear Drives
Gears and Pinions—Bevel • Double Helical • Single Helical • Speed Reduction • Spur
Housing Pinion—Rolling Mill
Lathes—Roll Turning
Levelers—Roller for Plate and Sheet
Machinery—Special • Flaking Mill • Rolling Mill
Machines—Pickling
Manipulators—Rolling Mill
Mills—Aluminum Foil • Bar • Billet and Blooming • Brass and Copper • Cold Rolling • Continuous • Edging • Four-High • Single Stand • Reversing and Tandem • Merchant • Plate Rolling • Precision • Sheet and Strip • Slabbing • Three-High • Tin Plate • Universal • Wire • Zinc Strip • Roughing and Finishing
Reels—Tension
Roll Ragging Attachments
Roll Polishers
Rolls—Alloy Iron • Chilled Iron • Sand and Chilled Iron • Steel
Saws—Hot and Cold
Screwdowns—Motor Operated • Hand Operated
Shears—Alligator • Bar • Billet • Bloom • Continuous Automatic • Sheet Mill • Gate or Guillotine • Lever • Plate • Power Driven • Scrap • Vertical
Straighteners—Angle • Bar • Rails and Shapes
Tables—Blooming Mill • Rolling Mill Feed • Transfer for Mills

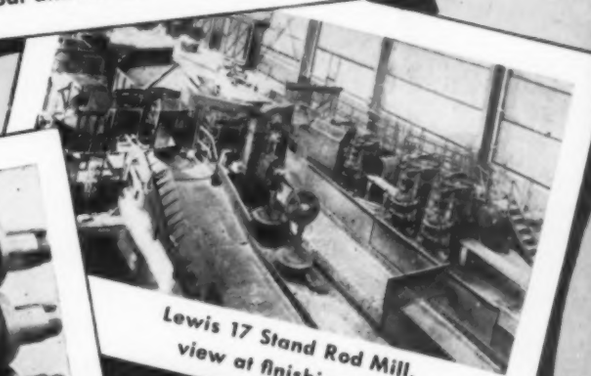
LEWIS FOUNDRY & MACHINE
Division of Blaw-Knox Co.
Pittsburgh, Pa.

Designers and Builders of Rolls and Rolling Mill Equipment

Setup Stands for Lewis 17 Stand Rod Mill installation

Lewis Three-High Jump Mill and Tables

Lewis Bar and Structural Mill Stand



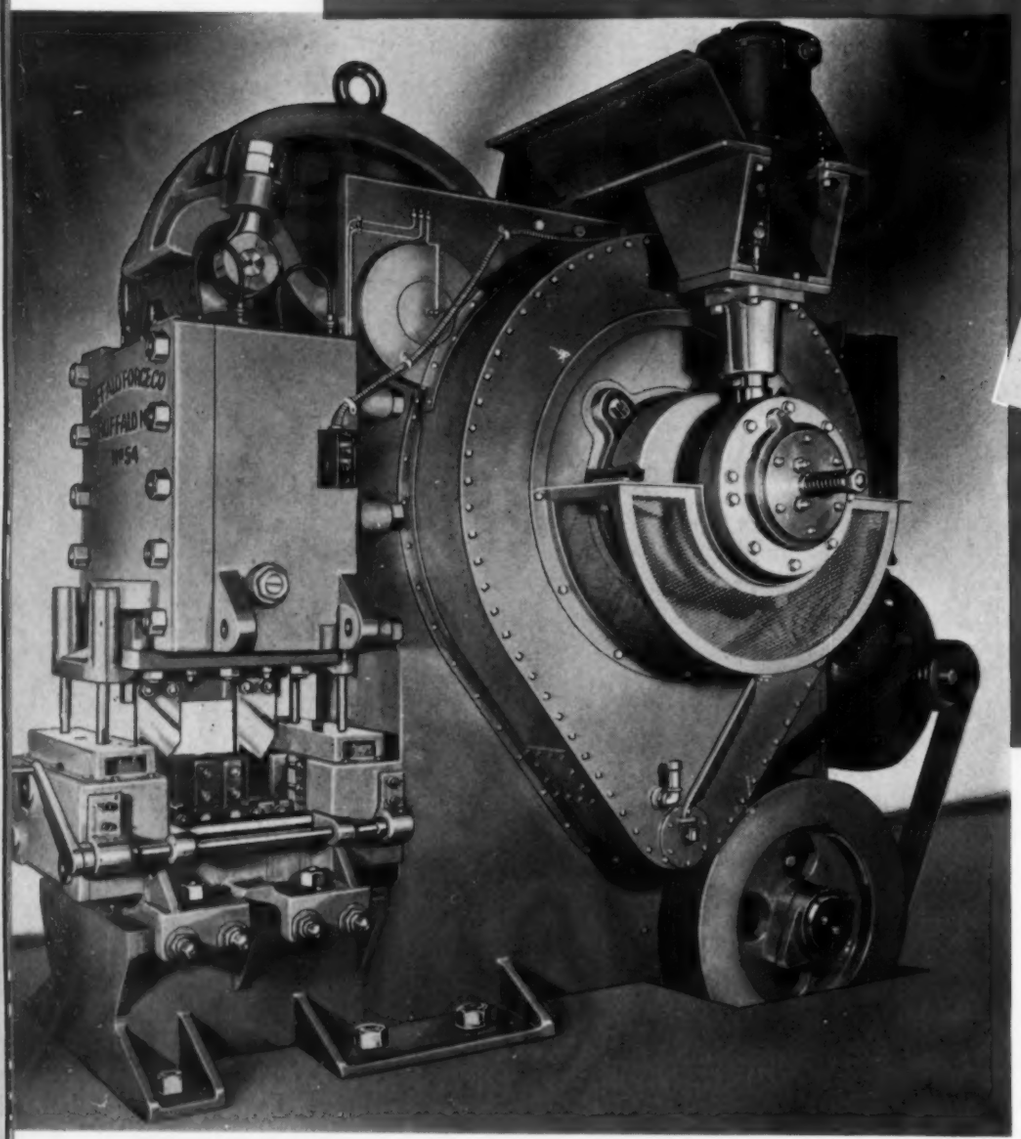
Lewis 17 Stand Rod Mill, view at finishing end

Lewis Superior "X" Rolls (High Alloy Grain Type)

LEWIS ROLLING MILL EQUIPMENT

PUNCH - SHEAR - BLANK

Cleaner, Faster, Easier



Your Copy On Request!

Write for Bulletin 3650, above, for facts on the twelve sizes of "Buffalo" Mill Type Shears to solve your heavy punching, shearing and blanking problems.

- **TOOLING SPACE ON 3 SIDES** simplifies setting up for each job, saves time.
- **LONGER POWER STROKES**, up to 8 inches.
- **BIG CAPACITY!** Twelve sizes, starting with 250 tons, ranging up to 1200 tons.
- **RUGGED CONSTRUCTION** to stand this extra heavy-duty service. Electrically welded steel plate frames.

"Buffalo" No. 54 Mill Type Shear

MACHINE TOOLS BY "Buffalo"

PUTTING MORE PROFIT INTO YOUR OPERATION

BUFFALO FORGE COMPANY

173 Mortimer Street BUFFALO, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

DRILLING PUNCHING
SHEARING CUTTING
BENDING

Specify

SQUARE D MILL-TYPE MASTER SWITCHES

Class 9003, Type AD
cam-type master switch
in dust-tight enclosure

Features that Count WITH

THE OPERATOR—

Return spring pressure adjustable to individual preference. Twice normal spacing isolates OFF point—makes it easy to locate. Offset handles permit group mounting.

THE SAFETY ENGINEER—

OFF position latch (removable when unnecessary). Spring return to OFF position (convertible from manual return device).

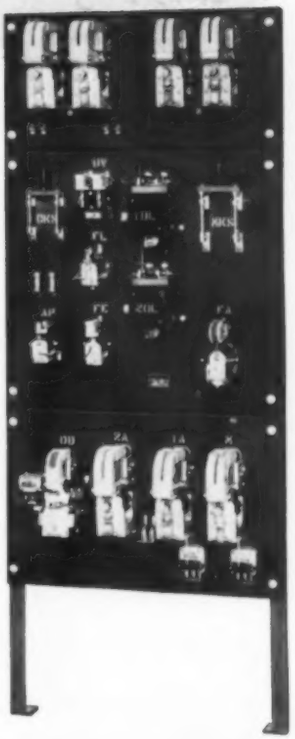
THE ELECTRICIAN—

Available with 1 to 6 points, reversing or non-reversing—1 to 12 circuits. Terminals, contacts and moving parts completely accessible. Generous wiring space.

Here's a mill duty controller to go with them

Specify both Square D master switches and mill duty controls on your next tough application. They are available for D. C. mill auxiliary and crane applications of all types.

Call your Square D Field Engineer or write for Bulletins 9003 (master switches) and 7950 (mill control). Address Square D Company, 4041 N. Richards St., Milwaukee 12, Wisconsin.

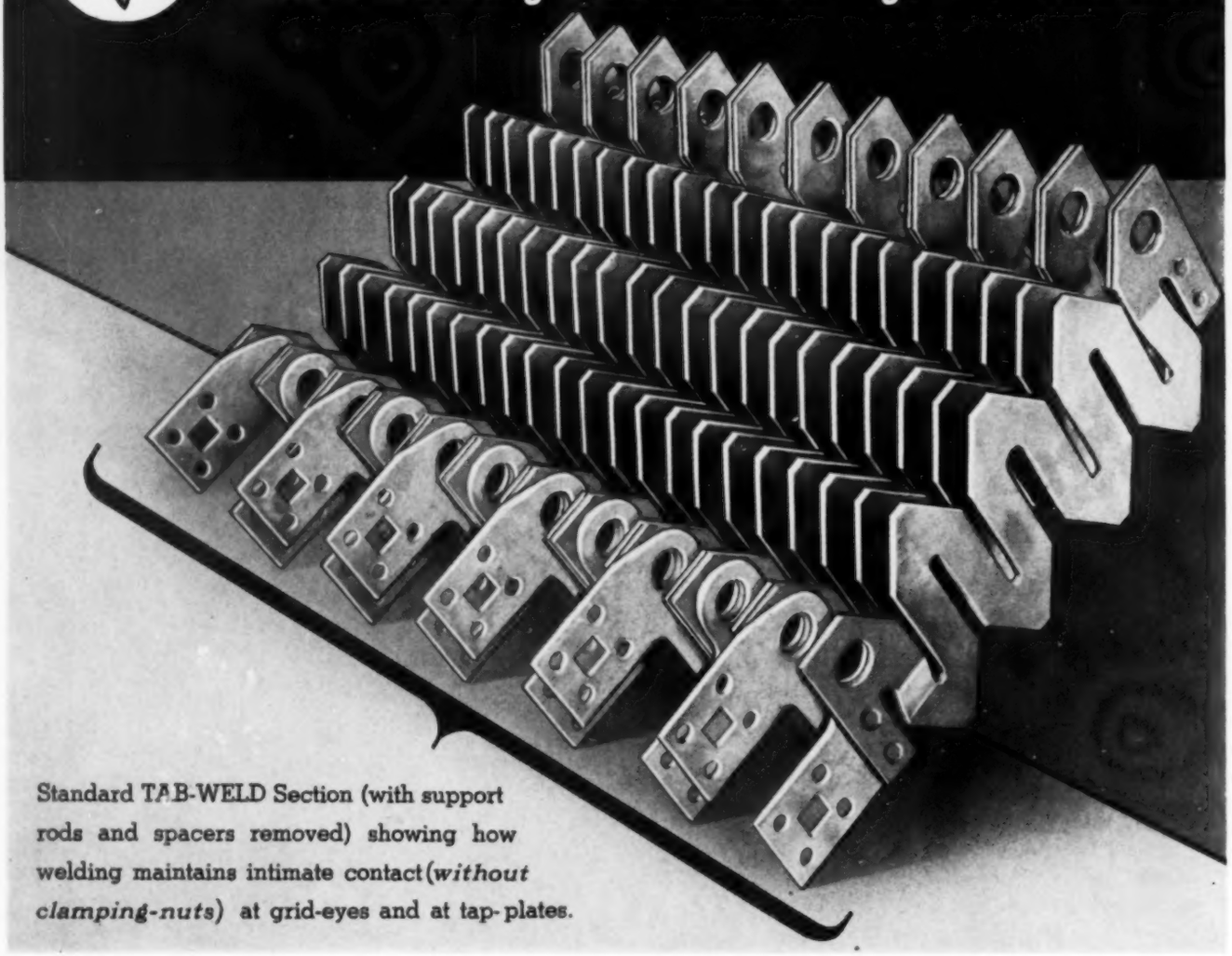


SQUARE D COMPANY

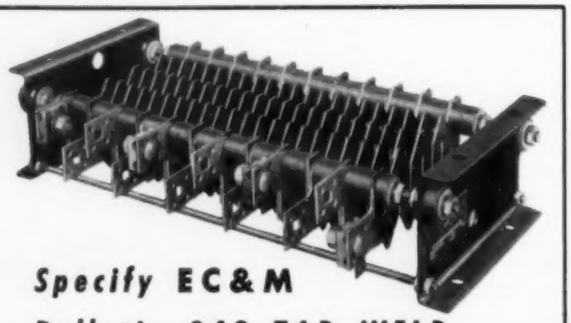
DETROIT · MILWAUKEE · LOS ANGELES

SQUARE D COMPANY CANADA LTD., TORONTO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

TAB-WELD Resistors eliminate burning where burning would cause high maintenance



Standard TAB-WELD Section (with support rods and spacers removed) showing how welding maintains intimate contact (*without clamping-nuts*) at grid-eyes and at tap-plates.



Specify EC&M Bulletin 942 TAB-WELD Plate Resistors for D-C. Crane and Mill Auxiliary Control.

MANY users of electric motor control are switching to EC&M TAB-WELD Plate Resistors because welding stabilizes the resistance value of each section and reduces maintenance. Numerous taps, convenient for affixing external leads at the desired point, simplify the replacement program.

Mill sections have grids connected in series. Internally, each section has *all* grids of the same size. Uniform mounting-hole dimensions permit stacking sections easily. Use TAB-WELD Sections from the storeroom shelf "as is"—no tap shifting or other shop alteration when a field replacement is needed.

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET • CLEVELAND 4, OHIO

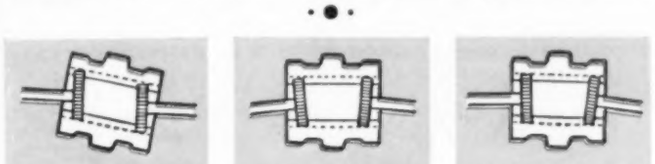
This

Metal-to-Metal Seal says "STOP" to Moisture, Dust and Grit!

That's why FAST'S COUPLINGS Give *Continuous* Service!

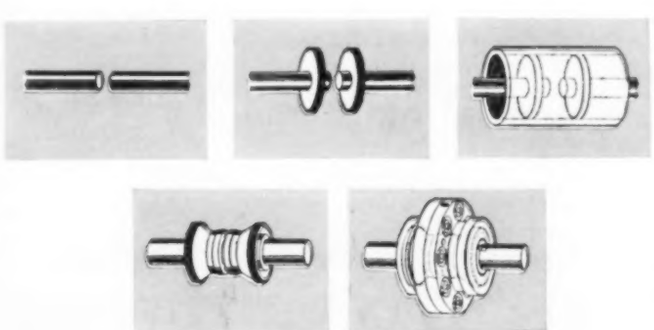
FAST'S self-aligning Couplings are completely free of perishable parts. They're all-steel throughout. At the vital spot shown above, this important feature is achieved through an *exclusive* "rocking bearing." This bearing is exclusive in providing a positive *metal-to-metal* seal that guards the load-carrying oil against troublesome moisture, dust and grit. The bearing is also exclusive in its correctly engineered position which allows *freedom of movement* to compensate for misalignment because its spherical base has the same axis as the hub spline faces. No perishable packing rings are used. There's nothing to wear, nothing to fail. Result: *uninterrupted* power transmission for all your installations!

We have a complete line of couplings for immediate delivery. No matter which type of Fast's Couplings you buy, you get the benefits of years of top engineering experience, Koppers' high standard of workmanship and unexcelled coupling service which assures you of spare parts no matter how old your couplings may be. That means longer machine life, lower upkeep costs, minimum shutdown losses! Koppers Co., Inc., Fast's Coupling Dept., 211 Scott St., Baltimore 3, Md.



Compensate For All Misalignment

The floating sleeve takes a neutral position. All forms of misalignment are compensated for between the lubricated faces of the splines, equally divided between driving and driven members. The entire assembly revolves as one unit.



Simple As A-B-C

Fast's self-aligning Couplings are amazingly simple for the important job they handle. A splined hub on each shaft end. A sleeve with internal splines to mesh. Oil in the sleeve, kept between the splines by centrifugal force, carries the load between the splines.

K KOPPERS

FAST'S *self-aligning* COUPLINGS

SEND FOR FREE CATALOG giving detailed descriptions, engineering drawings, dimension and capacity tables and typical installation photographs for the many types of Fast's Couplings. Fill out this coupon and mail it to: Koppers Co., Inc., Fast's Coupling Dept., 211 Scott St., Baltimore 3, Md.

Name..... Position.....

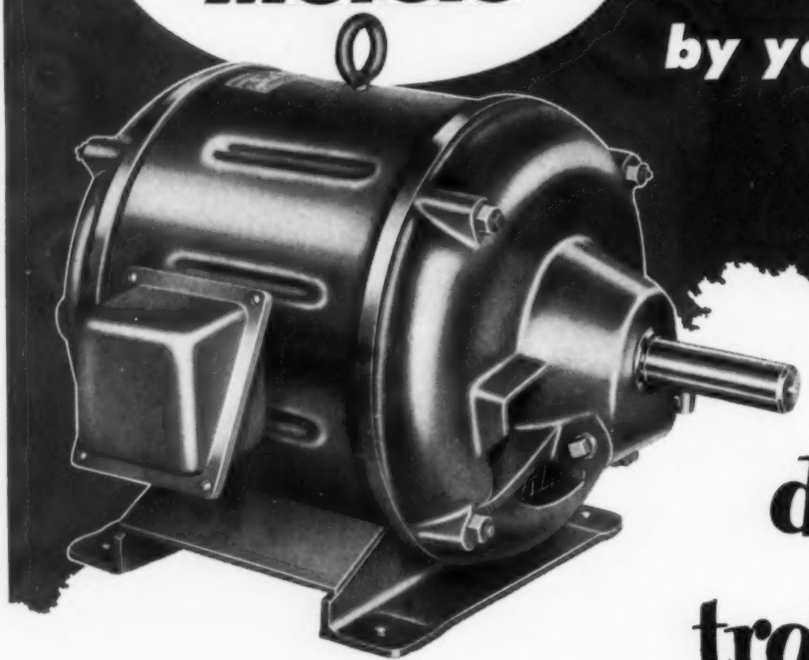
Company.....

Street..... City..... State.....

Wagner STEEL-FRAME Motors

Proved

by years of service!



quiet... dependable... trouble-free!

Since 1930, when Wagner started manufacturing steel-frame drip-proof motors, they have been *proved*—by years of hard usage in industry after industry.

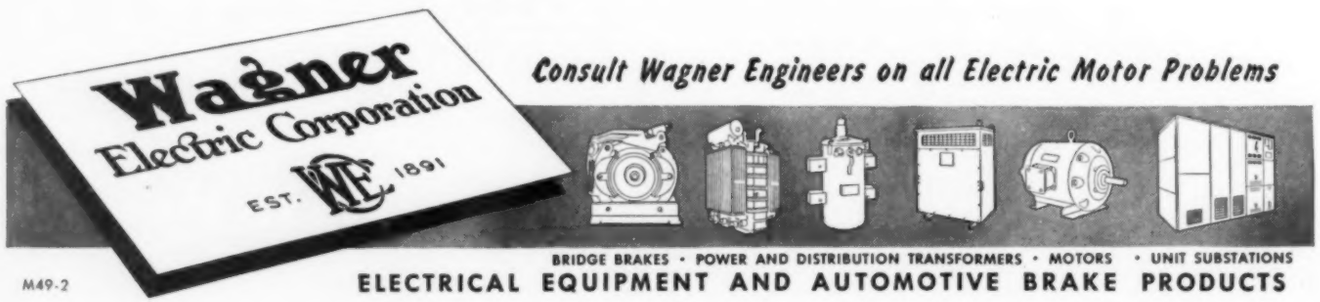
Today this time-tested design is available in polyphase motors through 326 frame size. The motor frames are formed of heavy rolled steel, shaped to accurately center the stator core and to provide passages for adequate ventilation. An auxiliary fan draws in air through the openings in the front endplate, forces it through these passages and out through the endplate openings on the drive end. Heat is effectively carried off from all parts of the motor.

These motors are available with either sleeve or ball bearings. They are completely drip-proof when mounted in the normal horizontal position, and by rotating the endplates are still drip-proof in the sidewall or ceiling horizontal positions.

Bulletins give full information on the complete line of Wagner Motors. Twenty-nine branches, located in principal cities, are ready to assist you whenever you have a motor problem. In addition, almost 500 authorized motor repair shops provide speedy, nationwide service facilities.

Wagner Electric Corporation

6483 PLYMOUTH AVE., ST. LOUIS 14, MO., U. S. A.



Consult Wagner Engineers on all Electric Motor Problems

BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL EQUIPMENT AND AUTOMOTIVE BRAKE PRODUCTS

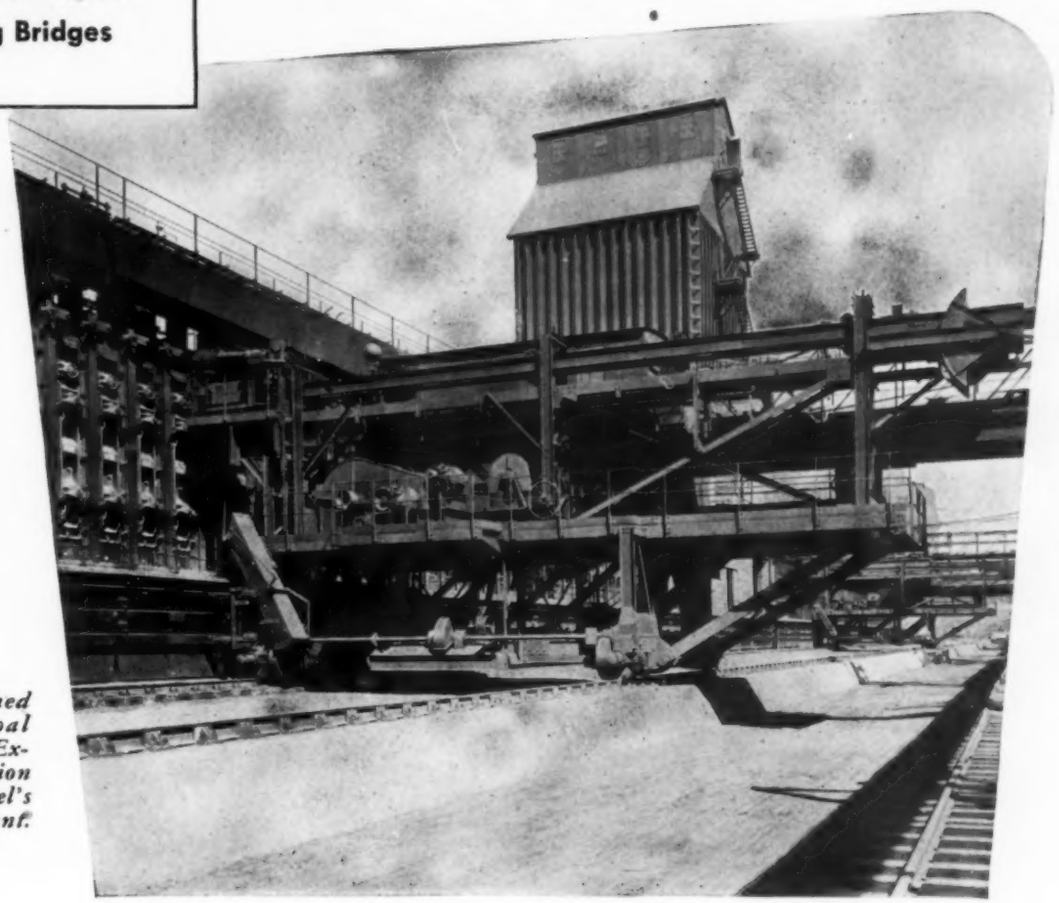
M49-2

Wellman will build it

- Coke Guides
- Coke Pushers
- Coke Quenching Cars
- Door Extractors
- Door Machines
- Coal Charging Larries
- Revolving Car Dumpers
- Coal Handling Bridges

Wellman Coke Pushers

for the Modern Coke Plant



Wellman Combined Coke Pusher, Coal Leveler and Door Extractor in operation at Bethlehem Steel's Lackawanna Plant.

● Many of the world's most modern byproduct coke oven plants are Wellman equipped. The Wellman Engineering Company's more than half-century experience in building heavy machinery guarantees sound design and expert construction. Wellman equipment provides peak economy, maximum safety and trouble-free performance under a wide variety of operating conditions. For conservative, reliable recommendations on your heavy equipment, phone or write:

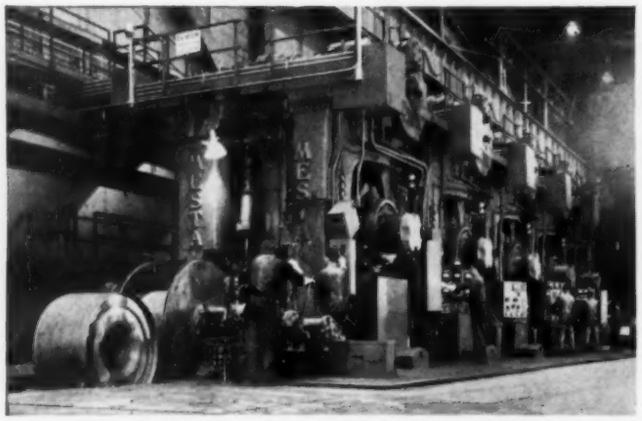
THE WELLMAN ENGINEERING COMPANY

7031 CENTRAL AVENUE • CLEVELAND 4, OHIO

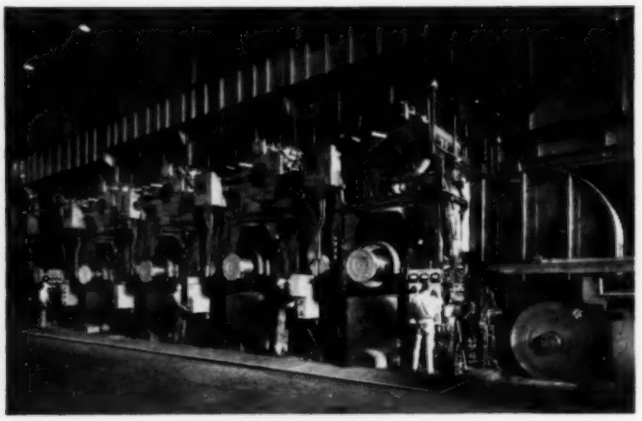
Torrington Bearings

Put on the Pressure

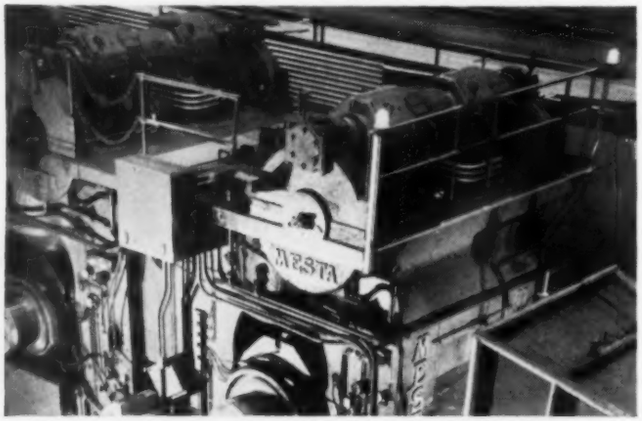
in Record-breaking Steel Mill



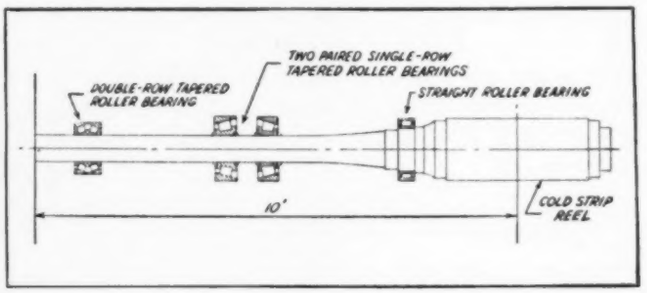
To roll strip fast is to roll it fine—in quality and uniformity. So, to make better strip, Mesta Machine Company designed and built the new Jones & Laughlin tandem strip mill for record speed—6,250 fpm. And it's equipped for top performance with Torrington Bearings on work rolls, screw downs and take-up reel.



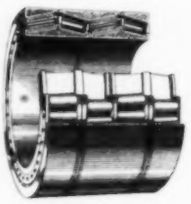
The pressure that reduces strip from 1/11" to 1/100" at *more than a mile a minute* imposes extreme loads on Work Roll Bearings. The design and high capacity of the Torrington four row Tapered Roller Bearings enable them to give exceptional service at this high speed despite tremendous radial and thrust loads.

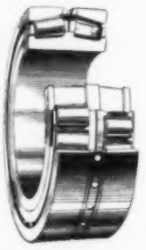


The mill screwdowns bear down on back-up rolls through Torrington heavy-duty Thrust Bearings, Type LR. The smooth operation and low starting torque of these bearings helps make the screwdowns the fastest in response action and the speediest ever installed on a tandem mill.



The take-up reel is of the mill-tested design shown here in cross-section, equipped with Torrington single and double-row Tapered Roller Bearings. Supporting the reel at one end only, the bearings are designed for maximum radial and thrust capacity to maintain high tension on the strip.



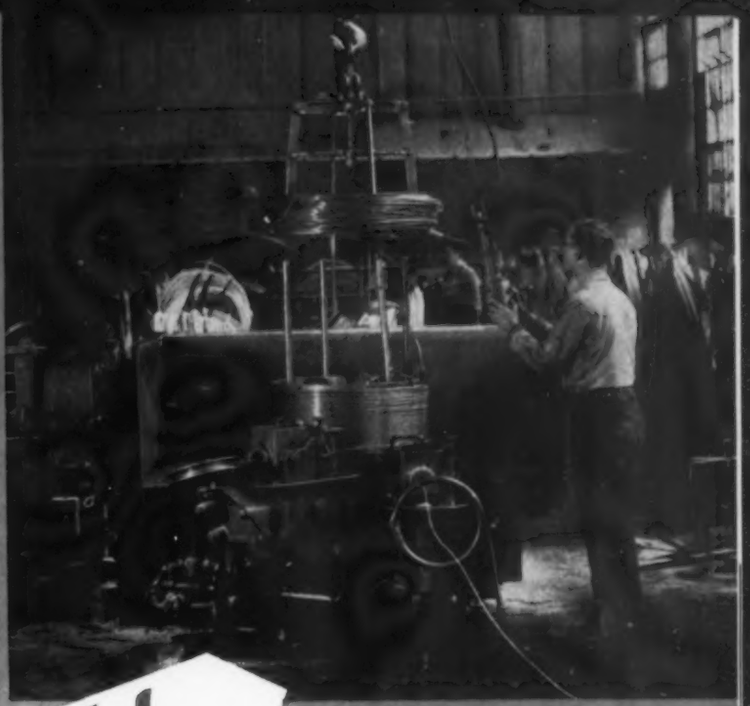


The exceptional service delivered by Torrington Bearings is based on our years of experience in designing, building and applying all major types of anti-friction bearings. For engineering assistance from design to maintenance, contact our nearest office. THE TORRINGTON COMPANY, South Bend 21, Ind., or Torrington, Conn. District offices and distributors in principal cities.

TORRINGTON TAPERED ROLLER **BEARINGS**

Spherical Roller • Tapered Roller • Straight Roller

Needle • Ball • Needle Rollers



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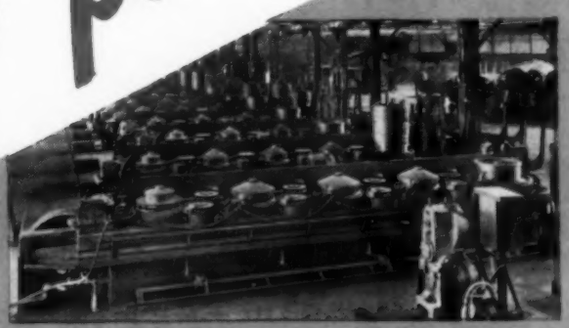
when your

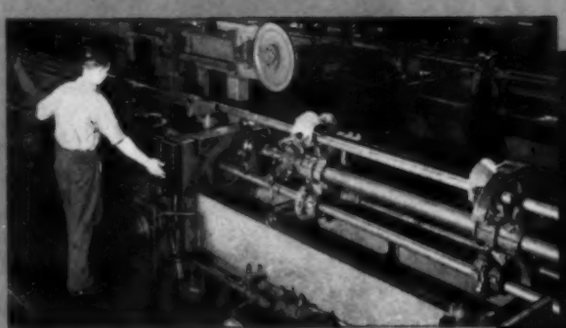
COLD DRAWING PROBLEM

meets

SOLUTION BY VAUGHN!



May we prove how VAUGHN MACHINERY can benefit your individual production—by cutting costs to increase profit? Our wide experience in all phases of cold drawing assures a completely practical approach to your problem. Write!



Vaughn

COLD DRAWING MACHINERY

"Quick on the Draw!"

VAUGHN MACHINERY

PROFITABLY USED BY LEADING WIRE MILLS SINCE 1871

THE VAUGHN MACHINERY COMPANY, CUYAHOGA FALLS, OHIO, U. S. A.

COMPLETE COLD DRAWING EQUIPMENT . . . Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

CARNEGIE-ILLINOIS DOES IT AGAIN!

BREAKS ITS OWN SLABBING MILL PRODUCTION RECORD FOR THE FOURTH TIME!

Since the world's first roller-bearing slabbing mill went into service at Homestead Works of Carnegie-Illinois Steel Corporation nearly four years ago, it has broken one production record after another.

Its latest achievement is the rolling of 169,338 net slab tons during the month of October 1948. That tops by 857 tons the record established exactly one year previously — October 1947 (168,481 tons).

The phenomenal performance of this mill have never even been approached by that of any other slabbing mill. For record-breaking performance in any type of new or existing rolling equipment, install Timken Balanced Proportion Roll Neck Bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address "TIMROSCO".

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
ROLL NECK BEARINGS

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

O. Z.'s *NEW* ALL-BAKELITE BUSHINGS

BEST BY TEST!

Results of Independent Laboratory Tests*

TORQUE ..... O. Z. *PROVED 36% STRONGER* than other bakelite bushings tested.

IMPACT ..... O. Z. *PROVED 44% STRONGER* than other bakelite bushings tested.

TENSILE STRENGTH .... O. Z. *PROVED 112% STRONGER* than other bakelite bushings tested.

FLAT COMPRESSION .... O. Z. *PROVED 32% STRONGER* than other bakelite bushings tested.

Now O. Z. offers you the strongest all-Bakelite insulating bushings made—56% stronger overall than other Bakelite bushings tested in independent laboratory tests (results above)—they bounce like a ball if dropped, won't break even on concrete. And for fast, easy installation and permanent protection, O. Z.'s provide these *plus* features:

- **Smooth, rounded edges completely protect wire insulation during pulling and when in service.**
- **Clean, deep threads let you spin-on the bushing with a twist of the wrist.**
- **Ribbed outer surface provides a grip for slippery hands and permits tapping with screw driver.**

O. Z. Bakelite bushings cost no more than other Bakelite bushings, are fully approved by Underwriters' Laboratories and are available in sizes from ½ inch to 6 inches. Samples sent on request.

**Name and photostatic copy of report will be furnished if you wish.*

NET TRADE PRICES

Cat. No.	Pipe Size	Std. Pkg.	Ctn. Qty.	Lbs. Wt. Per 100	Less Carton Price Per 100	Carton Qty. Price Per 100	Std. Pkg. Price Per 100
A-50	½"	400	100	1½	$ 4.60	$ 3.60	$ 2.90
A-75	¾"	400	100	2	5.75	4.50	3.60
A-100	1"	200	50	3	9.20	7.20	5.75
A-125	1¼"	100	25	4½	26.50	20.30	16.25
A-150	1½"	100	25	6½	30.00	23.40	18.75
A-200	2"	40	20	9	36.00	28.10	22.50
A-250	2½"	20	20	14	58.50	—	36.50
A-300	3"	10	10	18	64.00	—	40.00
A-350	3½"	10	10	22	80.00	—	50.00
A-400	4"	10	10	25	96.00	—	60.00
A-500	5"	5	5	34	210.00	—	130.00
A-600	6"	2	2	45	400.00	—	250.00

CONDUIT FITTINGS • CABLE TERMINATORS
CAST IRON BOXES • GROUNDING DEVICES
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Buy O.Z. and you'll see why Engineers say, "They're OK if they're O.Z."

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O.Z. ELECTRICAL MANUFACTURING COMPANY, INC.

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Increased Output

specify

"BIRDSBORO SPECIAL" *Rolls*

Designed particularly for 2-high and 3-high blooming and billet mills, "Birdsboro Special" rolls are made with the correct analyses and physical properties to meet your specific roll problem. Cast in our own foundries of the toughest and strongest alloy steels, they assure greater tonnage volume through long roll life and high speed operation.

If there is a metal reduction problem in the manufacture of your products, consult Birdsboro engineers for help in cutting, operating and maintenance costs as well as stepping up your production.

For GENERAL PURPOSE ROLLING of:

Iron	Stainless Iron
Mild Steel	Stainless Steel
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Birdsboro Steel Foundry & Machine Co. • Birdsboro, Pa.

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Designers and Builders of:
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Safe and Sure . . .

THE *Bailey*

MECHANICAL

GOGGLE VALVE

for

GAS MAINS
GAS WASHERS
COKE PLANTS
BOILER PLANTS

- SAFE . . . because the powerful clamping device assures gas-tight seal when the Bailey Mechanical Goggle Valve is closed.
- SURE . . . because the same device promptly and positively frees the plate when valve is to be opened.
- DEPENDABLE . . . because the clamping device always works, regardless of time between operations.
- ECONOMICAL . . . because the Bailey Valve is correct in design and built for long, trouble-free service.

Made in sizes from 6" to 72". This is a 60" x 48" valve.

Totally enclosed type—6" size.

WILLIAM M. *Bailey* COMPANY
ENGINEERS
LEADERSHIP THROUGH QUALITY
PITTSBURGH PENNSYLVANIA

WHEN THE ANSWER TO THESE PROBLEMS WILL ADD PROFIT TO YOUR OPERATIONS——

- REDUCE FUEL CONSUMPTION
- STOP BURNING STEEL
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- ELIMINATE RECUPERATORS & GENERATORS
- INCREASE DIE LIFE

get in touch with **STEEL PROCESSING CO.**
Fort Pitt Bridge Works Subsidiary
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You'll Save . . .

You'll Get Faster Deliveries with *Pennsylvania*

STANDARD PARTS POWER TRANSFORMERS

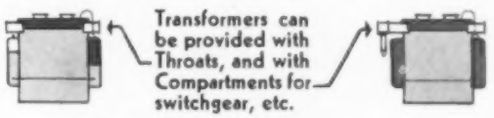
Available in the following sizes:

Three Phase: Up to 10,000 Kva, 34 Kv
Single Phase: Up to 5,000 Kva, 34 Kv

This new line of Pennsylvania Power Transformers was designed to include the desirable features of custom-built transformers, at quantity production prices. Streamlined and standardized methods of manufacture, coupled with the use of standard designs and standard parts, shorten engineering and production time. This reduces the price of the transformer and shortens the delivery time.

Auxiliary tanks, in most cases, do not add to the projected floor area.

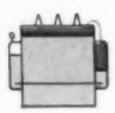
The Sealed Tank and Inert Gas Pressure Systems can be changed, in the field, to Inert Gas-Oil Seal, without difficulty and without changing any parts. Inert Gas Pressure System can also be changed to Sealed Tank.



Transformers can be provided with Throats, and with Compartments for switchgear, etc.

Standard Parts Transformers can be supplied with any method of oil preservation.

Auxiliary tanks, welded to each end of the transformer and connected to each other and to the main tank, form the following oil preservation systems:

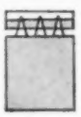


Inert Gas-Oil Seal

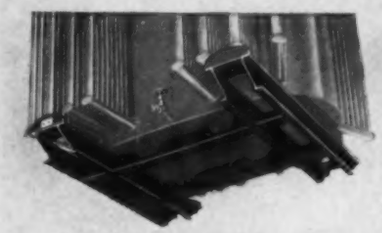
Sealed Tank

Inert Gas Pressure System

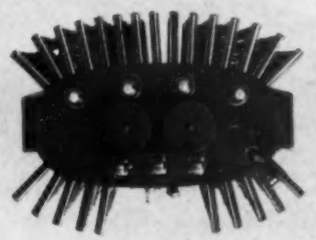
Oil expansion tank can be provided instead of auxiliary tanks.



Standard Parts Power Transformer. 3750 Kva, 3 Phase, 60 Cycles, OA, 55°C. Voltage: 12,000 Delta-2,400 Delta/4,160 Y.



Base for Standard Parts Transformer. Base is designed to simplify jacking, pulling, rolling, and painting.



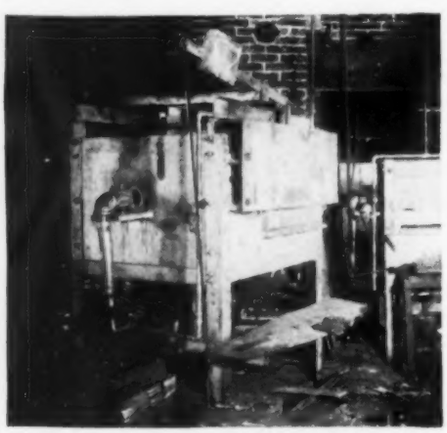
Top of 4000 Kva Standard Parts Transformer. Note how auxiliary tanks fit into ends of the transformer and do not add to the length of the transformer.

Pennsylvania TRANSFORMERS

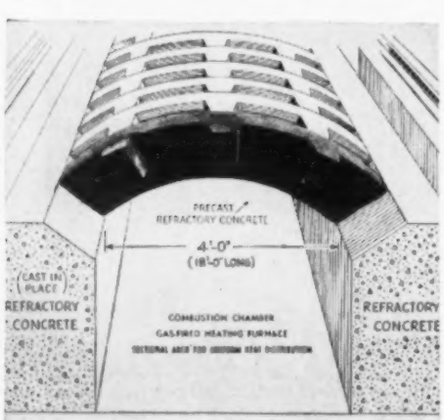
For further information, write for Booklet No. 1492

Pennsylvania
TRANSFORMER COMPANY
PITTSBURGH 12, PENNSYLVANIA

Incinerator Arch and Floor, quickly installed with Castables. No cutting, fitting, or ramming. Upkeep costs are low.



Heat-treating Furnace built with Castable Refractories. Cuts heat loss . . . prevents infiltration of outside air. Gives durable service life.



Combustion chamber of Gas-fired Heating Furnace. Each section of Arch is cast in one piece with Refractory Concrete. No mortar joints. Side walls and floor cast solid.

Practically any shape you want...

★ **FURNACE WALLS,**

★ **ARCHES, HEARTHS,**

★ **DOOR LININGS,**

★ **SPECIAL SHAPES**

with a Castable Refractory

Quickly *adaptable* to any size, shape or thickness—Castable Refractories are invaluable first-aid for emergency repairs. Rapid hardening Castables are ready for service in 24 hours or less.

They're easy to use, too. Add water to the packaged mixture, cast it in a simple form or mold. Large jointless sections are as easy to cast as small special shapes. No cutting or fitting.

For walls, arches, hearths, you get a one-piece refractory that reduces heat loss, prevents infiltration of outside air. No shrinkage to bother about. High spalling resistance. Low upkeep.

You're sure of fast, *adaptable* construction and long, durable service when you specify a Castable Refractory made with LUMNITE cement. You get a balanced, tailor-made refractory that results from the blending of selected materials. You get suitable refractory aggregates with cold-setting, high strength binder, LUMNITE.

Castables to meet different temperature and insulation requirements are made by manufacturers of refractories and sold by their distributors. For further information, write to LUMNITE DIVISION, Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), Chrysler Building, New York 17, N. Y.

Specify **CASTABLE REFRACTORIES** *made with* **LUMNITE**

IS-L-3

LUMNITE A UNIVERSAL ATLAS PRODUCT **FOR REFRACTORY CONCRETE**

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—ABC Network*

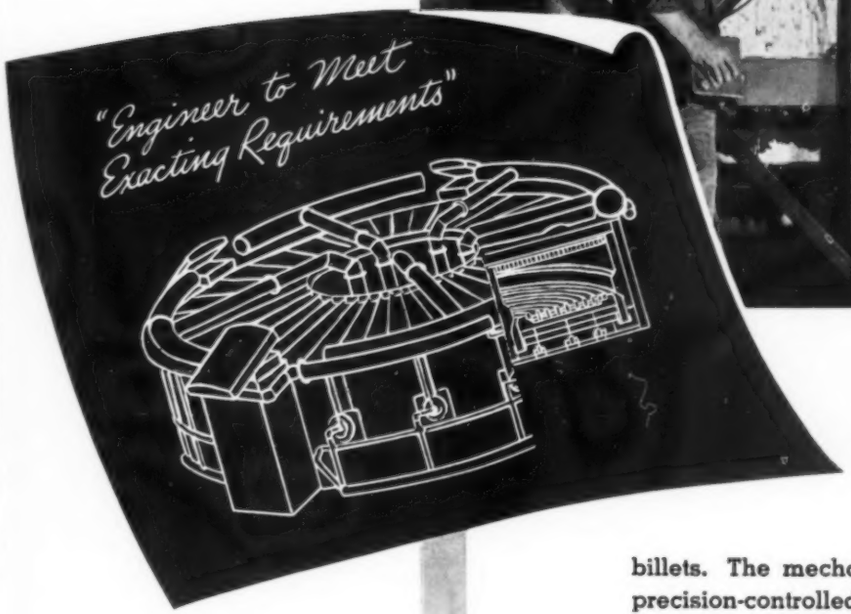
DESIGNED AND BUILT BY

SALEM

in a special application of Salem-proved mechanization. Giant "hands" and precision control are here combined to charge and withdraw heavy billets . . . . . smoothly, surely, swiftly . . . . . at the rate of five per minute.

ABOVE: Automatic Billet Charger

RIGHT: Automatic Billet Discharger



These full color photographs, made at the Beaver Falls, Pa. plant of the Babcock and Wilcox Tube Company, clearly illustrate the automatic charging and discharging of heavy steel billets. The mechanisms pictured feed the most up-to-date, precision-controlled automatic heating furnace with unerring accuracy. Working at a rapid rate, the finely adjusted manipulators have put production on a flow-line basis.

Every Salem office has the facts. Address nearest city listed below.

r-8

Salem Engineering Company

HEADQUARTERS FOR HEAT TREATING DESIGN

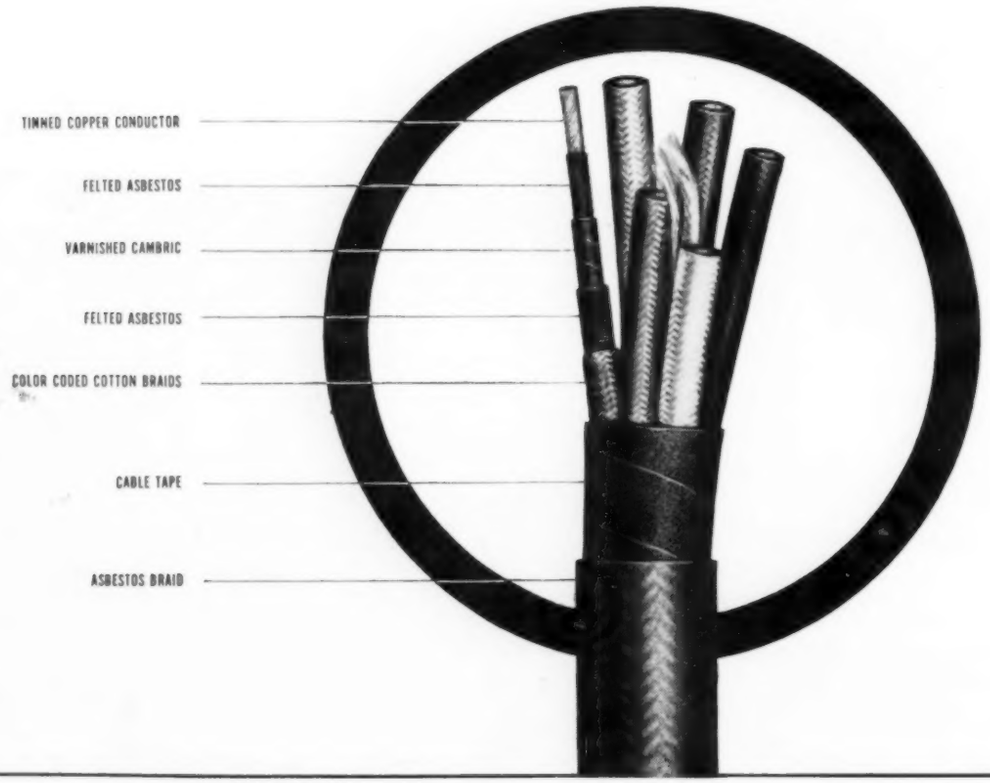
Salem, Ohio *Southwest Office, Fort Worth, Texas*

SALEM ENGINEERING (CANADA) LTD., TORONTO, ONT.
SALEM ENGINEERING COMPANY, LTD., SHEFFIELD, ENGLAND

This Just Goes to Show...

with cable, it isn't the cost

—it's the upkeep!



An Eastern Electric Utility used single conductor ROCKBESTOS AVC Wires and Cables for years.

But for "economy" they had been using ordinary low temperature control cable in their generating stations on vital control circuits to main steam boilers — burner tilt mechanisms and main power valves.

These circuits are close to steam lines — where it's hot! *Ordinary* control cables didn't stand up.

Convinced that ROCKBESTOS AVC . . . *Asbestos-Varnished-Cambric* . . . Permanent Insulation pays for itself in longer life, less maintenance and fewer outages, the Company has now replaced the ordinary control cable in this hot spot with ROCKBESTOS Table MD AVC Control Cable.

It will pay *YOU* to know the ROCKBESTOS story! Write.

ROCKBESTOS PRODUCTS CORPORATION
NEW HAVEN 4, CONN.

NEW YORK CLEVELAND DETROIT CHICAGO
PITTSBURGH ST. LOUIS LOS ANGELES OAKLAND, CAL.

WIRES and CABLES *by*

ROCKBESTOS

. . . . dare to be better

OVER 30 YEARS EXPERIENCE BUILT into Steel Grid Resistors designed by POST-GLOVER

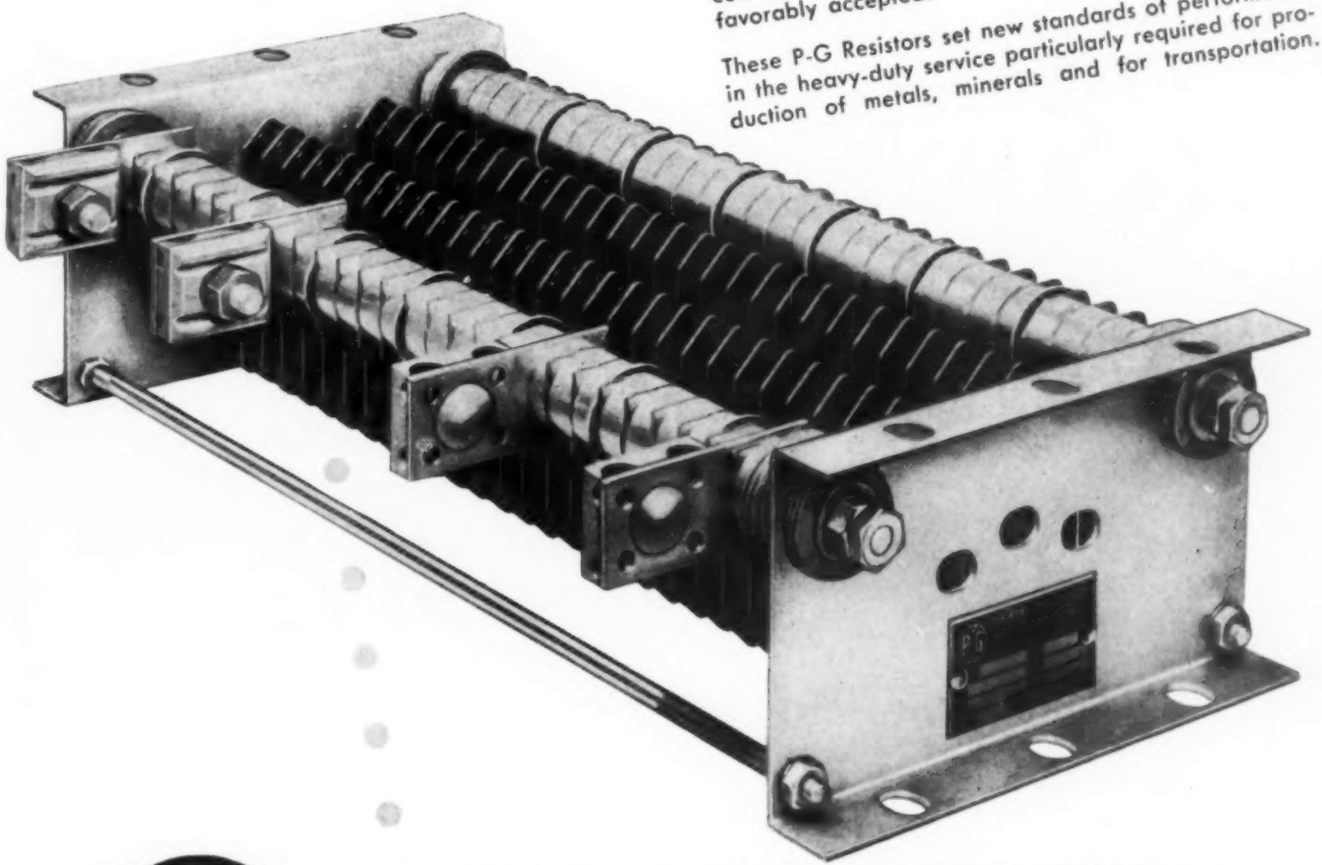
More than thirty years ago, to meet a demand for resistors capable of longer, trouble-free service, Post-Glover introduced a "Steel Grid Resistor."

These original "nonbreakable" resistors met instant favor, since they operated continuously under such adverse conditions as the dust, moisture and vibration of coal mining service.

From the experience thus accumulating through years of intimate association with actual heavy-duty operating conditions, the present P-G Type T2 Steel Grid Resistor was developed.

The all-steel construction, mica insulation, provision for expansion as well as resistance to moisture and corrosion of Type T2 continues more than ever to be favorably accepted.

These P-G Resistors set new standards of performance in the heavy-duty service particularly required for production of metals, minerals and for transportation.



SPECIFY P-G FOR YOUR NEXT APPLICATION

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

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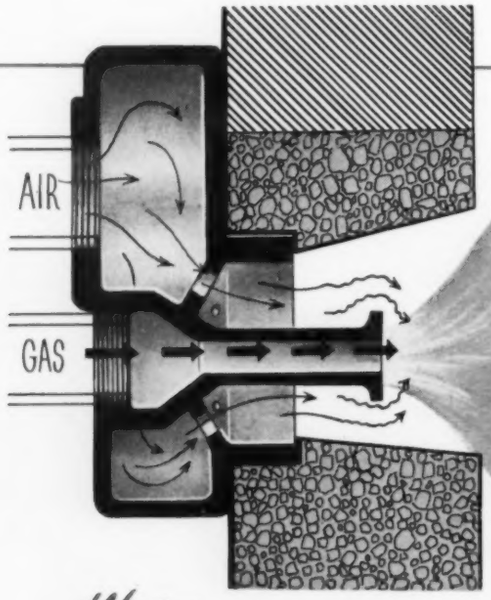
Get { MORE from your furnace! MORE from your fuel!

BLOOM BURNER

TEMPERED-FLAME

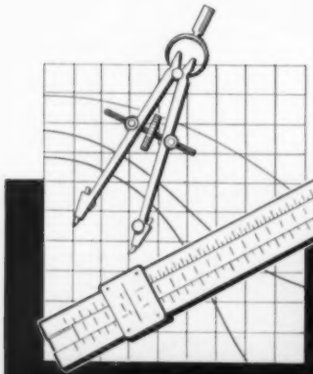


Write for bulletin giving full details of the Bloom Tempered Flame Burner.

GREATER *Flexibility* — Furnace temperatures as low as 400° F. or as high as 2450° F. can be obtained and maintained without difficulty. The Tempered Flame Burner will light at full capacity, and will burn as long as it has fuel.

UNIFORM *Temperature* — With this Bloom burner, the desired temperature can be readily maintained uniformly throughout the furnace chamber.

FASTER *Heating* — Accomplished because cold spots are eliminated. Thus the time of annealing cycles is reduced.



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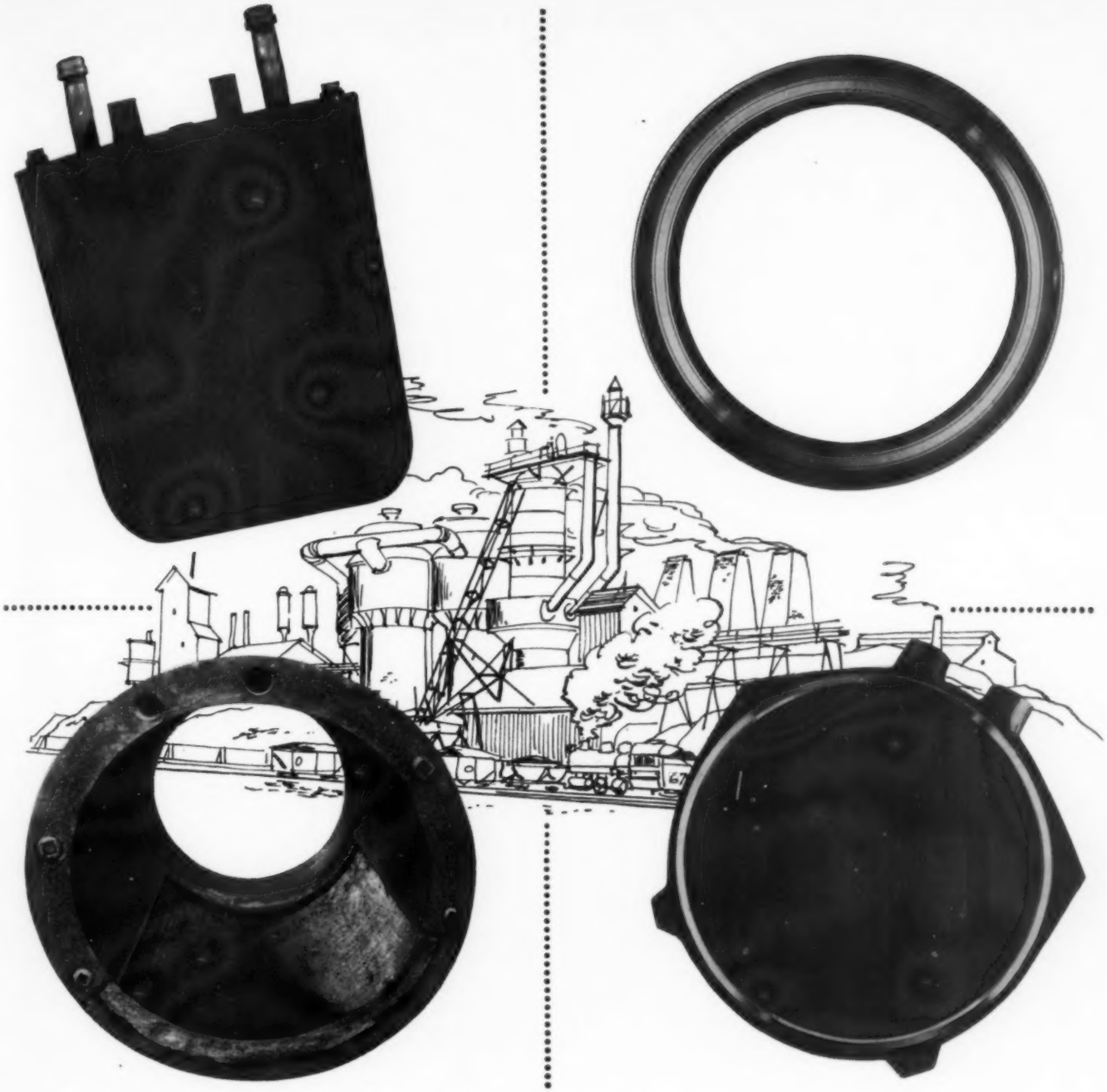

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N-B-M Copper Castings are the result of improved alloying and close foundry control perfected in our metallurgical and engineering research laboratories. These castings provide greater heat resistance for your most troublesome burn-out points, greater production between stack shutdowns. Always specify N-B-M Copper Castings—they give you longer, more economical service.

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- Cinder Notch Coolers
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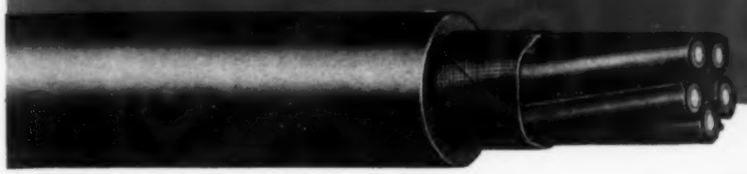
Okonite's basic formula for insulation forms basis for LONG CABLE LIFE



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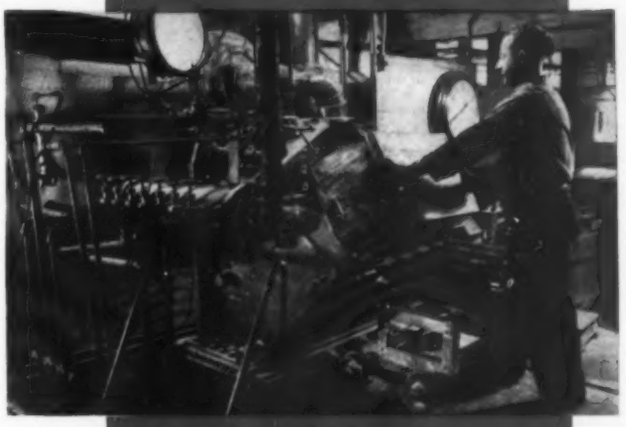

Mixed with 70 Years Experience

TODAY'S high installation and replacement costs tend to underscore the long term value of long-lived cable. And today, as always, no cable can be longer-lived than its insulation.

For 70 years, Okonite engineers have realized this. From the beginning they have adhered to the basic time-proved formula for Okonite rubber insulation. As a result, Okonite insulation remains the first choice of value-wise electrical engineers in the industrial, utility and transportation fields alike.

From the selection of the ingredients for the basic formula, through the processing and application of the finished insulation, the Okonite laboratories maintain close control at every step. For example, only natural rubber from the sturdy wild trees of the upper Amazon is permitted in the Okonite insulation. This is but one of the reasons for the long service records compiled by Okonite cables.

Note these typical examples of how Okonite insulation keeps its toughness and elasticity after long years in service:

Installation Conditions	Years In Service	Tensile Strength	Elongation 2" —
Honolulu, T. H. Communication Cable	32	1450	10.7"
New Haven, Conn. Substation Feeder Cable	30	1644	9.8"
New York, N. Y. Railroad Jumper Cable	24	1051	10.5"

If it's long-lived cable you want, specify Okonite time-tested rubber insulation as the basic component. And when you order an Okonite insulated cable, remember every length has been uniformly vulcanized in a continuous metal mold.

For further technical data, write for Research Publication IS-101. The Okonite Company, Passaic, New Jersey.

7211

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ORDINARY SILICA CEMENT

TAYCO-40 SILICA CEMENT

THIS?

OR THIS?

TAYCO-40 is the ideal low alumina silica cement for bonding *super-duty* silica brick and shapes.

Ask for New Bulletin on TAYCO-40

Write for a sample of TAYCO-40 and your copy of new Bulletin No. 507, containing interesting data and showing different applications of TAYCO-40.

Compare the *smooth workability* of TAYCO-40, with the poor trowelling properties of ordinary silica cement as shown in above photographs. Ordinary silica cements "crawl" when trowelled, making it difficult to rub or slide the brick in place. Joints are sandy, tend to be thick. TAYCO-40, unlike ordinary silica cements, will retain water and remain plastic when applied to porous silica refractories, allowing ample time for laying and fitting. TAYCO-40 is *easy* to use. Thinner, tighter joints are obtained. Less cement is required. Losses in mixing and handling are reduced.

TAYCO-40 has a softening point nearly equal to the best grades of silica brick. In furnace heat-up, there is no pinching of the brick as the ceramic bond is *not* formed in TAYCO-40 until *after* the bricks have passed through critical stages where abrupt volume changes occur.

For an *easier, better* masonry job, bond your silica refractories with TAYCO-40. Can be dipped, poured or trowelled. Used by leading steel mills and glass plants throughout the United States and Canada.

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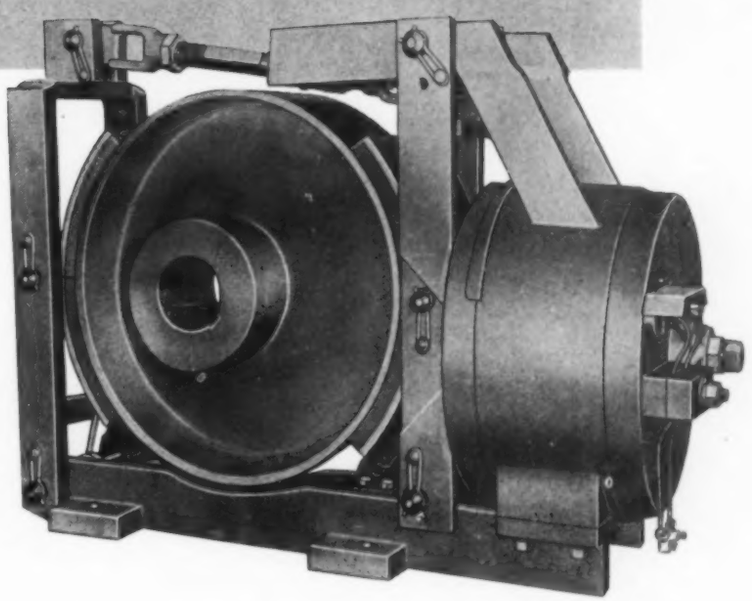
"We said it and we're glad of it"

CLARK

BULLETIN 106 D.C. SHOE BRAKES

are

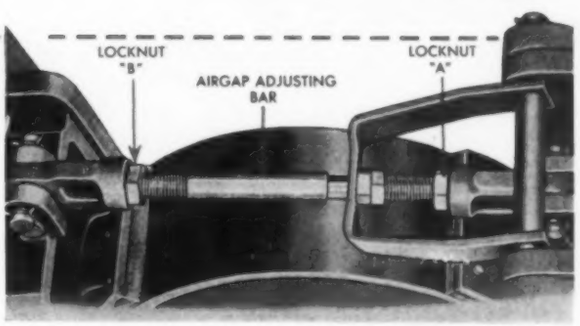


1. The only brakes with one adjustment for lining wear. And that adjustment is on the top—not on the bottom—not on the sides—not on the ends—but on TOP, where you can see it and get at it easily.
2. The only brakes designed to fit the new 600 SERIES Type Mill Motors.
3. Operated like a nut cracker—a basic principle in mechanics—resulting in equal distribution of forces, and dependable operation.
4. The simplest to adjust.
5. Very easy to install.

--and here's where----

the only adjustment needed—and that's for lining wear—is made. Right on top.

Simply loosen locknuts A and B and turn the adjusting bar until the gauge nut sleeve is again flush with the gauge rivet. With this adjustment made, the brake is returned to its original setting, automatically providing correct shoe clearance, air gap and torque setting.



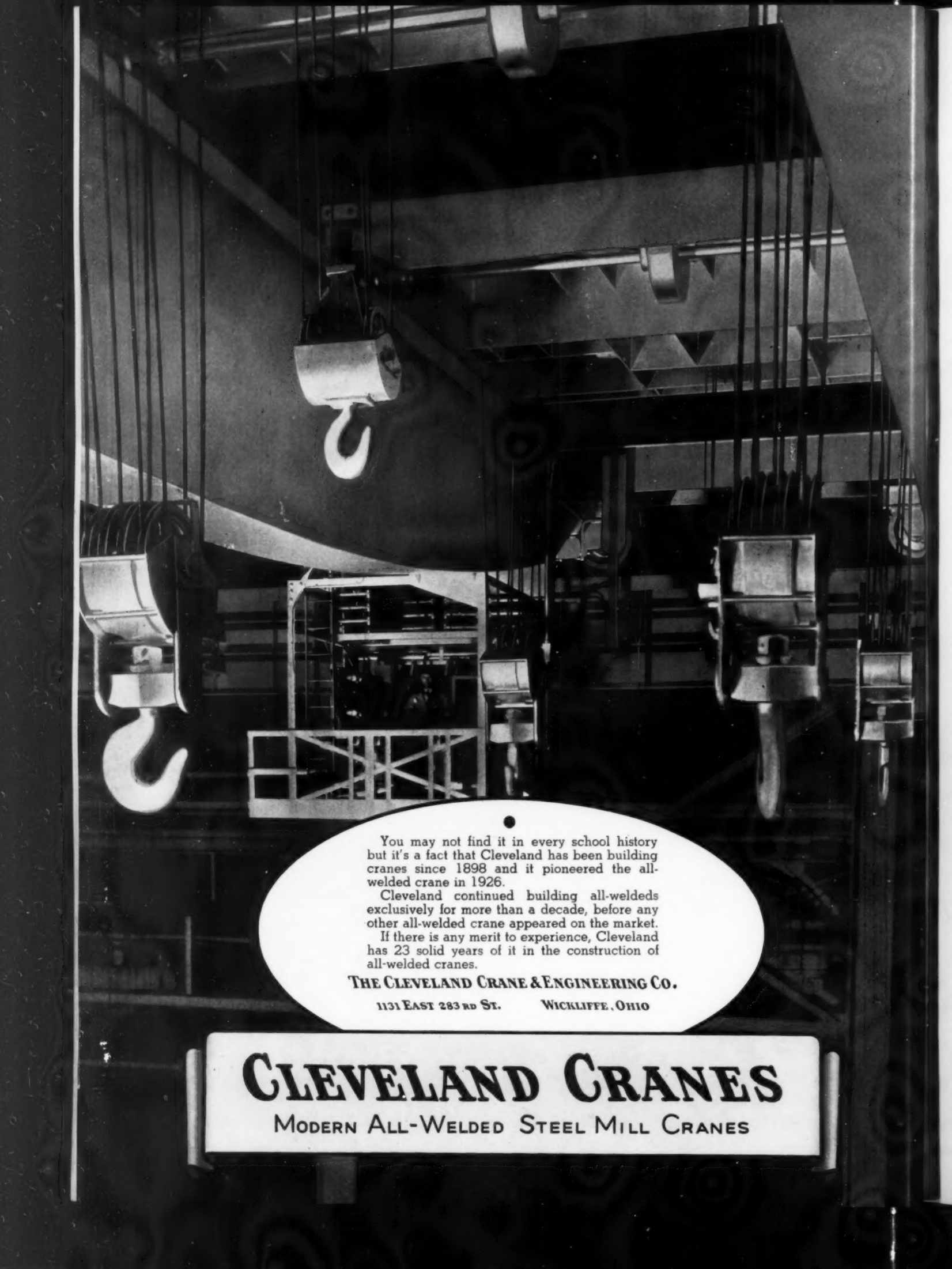
Over twenty-five hundred CLARK Bulletin 106 D. C. Brakes were built during the war—hundreds more are in service on Mill installations such as Cranes, Charging Machines, Side Guards, Screwdowns, Transfer Cars, etc. and reports of outstanding performances are being received.

The nearest CLARK representative will gladly consult with you on your Brake problems.

EVERYTHING UNDER CONTROL

THE CLARK CONTROLLER CO.

1146 EAST 152nd STREET, CLEVELAND 10, OHIO



You may not find it in every school history but it's a fact that Cleveland has been building cranes since 1898 and it pioneered the all-welded crane in 1926.

Cleveland continued building all-weldeds exclusively for more than a decade, before any other all-welded crane appeared on the market.

If there is any merit to experience, Cleveland has 23 solid years of it in the construction of all-welded cranes.

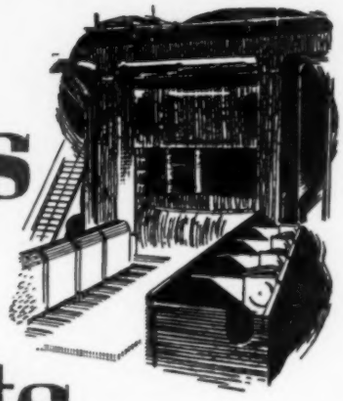
THE CLEVELAND CRANE & ENGINEERING CO.

1131 EAST 283 RD ST. WICKLIFFE, OHIO

CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

Crops and Shorts



BEGINNING with this issue, readers will find the latter part of the IRON AND STEEL ENGINEER has been departmentalized in order to make it more convenient. Under the headings "Dateline Diary," "Industry News," "Personnel News," "Equipment News," and "Publication Service," we will bring you broader coverage of the information needed to keep up-to-date on the iron and steel industry.

▲

A government spokesman recently stated that farm prices are dropping because of the actions of the 80th Congress. And all along we've been hearing that the "luckless 80th," through its removal of price controls, was responsible for high prices.

▲

WE have often commented upon the criticism of "big business." A recent survey of the 120 biggest corporations in the country shows that in only four companies does any individual own as much as 10 per cent. The 120 companies are owned by 6,126,713 stockholders, who outnumber the 4,464,000 employees by almost 40 per cent. It is also estimated that 40 per cent of the stock in these companies is held by schools, hospitals, cemeteries, and insurance and investment companies, who in turn represent millions of other individuals. Hence, "big business" is merely a collection of little guys.

▲

WE have also often stated that bigness is essential in heavy industry if economy is to be attained. An excellent example of this is to be found in the wide strip mills now being installed and planned in France. The mill now under construction, representing a $27,000,000 investment, will be owned by Usinor, a combine of two French steel companies. The $50,000,000 installation now planned will be owned by Sollac, a combination of eight French companies.

▲

THE reason a dollar won't do as much as it once did is because people won't do as much for a dollar as they once did.

▲

TESTIFYING before a congressional subcommittee on profits, Enders M. Voorhees, chairman of U. S. Steel's finance committee, stated that a bessemer steel plant, blooming mill and billet mills, estimated at $34,500,000 in November, 1945, is now estimated at $57,000,000, an increase of 65 per cent. The increase in the cost of cold reduced sheet capacity since November, 1944, is 57 per cent and the increase on a seamless pipe mill since September, 1945, is 69 per cent.

In some instances the cost of replacing equipment purchased before the war is now 2½ times prewar prices. For example, the lowest competitive bid received in 1948 to build a blast furnace was 110 per cent greater than the actual cost in 1941. The increase for a blooming mill over a similar mill built in 1943 was 167 per cent. The cost of coke oven capacity per ton in 1948 was 173 per cent greater than in 1939.

This is the problem the industry faces in its plans for expansion and for the future.

▲

FROM the Houghton Line: "One reason why it's hard to save money is that our neighbors are always buying something we can't afford."

▲

A tentative estimate of automotive production for 1948 has been set at 5,056,000 passenger cars and trucks.

▲

MODERN definition of a university: "An institution which has room for 2000 in classrooms and 50,000 in the stadium."

▲

TYPICAL of the too prevalent "devil-take-the-hindmost" attitude that prevails today is a proposal from the United Mine Workers of America that the state of Pennsylvania place a tax on fuel oil and natural gas used in the state or flowing through the state. This is no doubt in retaliation for some taxes arising from the new Pennsylvania law, which allows local taxing bodies to tax anything not taxed by the state. Some localities have started to tax coal as it is removed from the ground.

▲

JUST showing that the attitude toward women drivers is not a recent prejudice, a Michigan professor has discovered that the Romans passed a law in 205 B.C. prohibiting women from driving chariots.

▲

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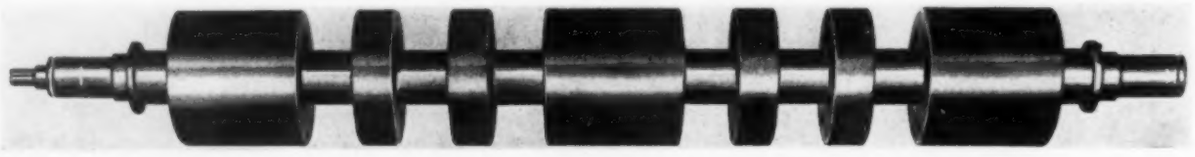

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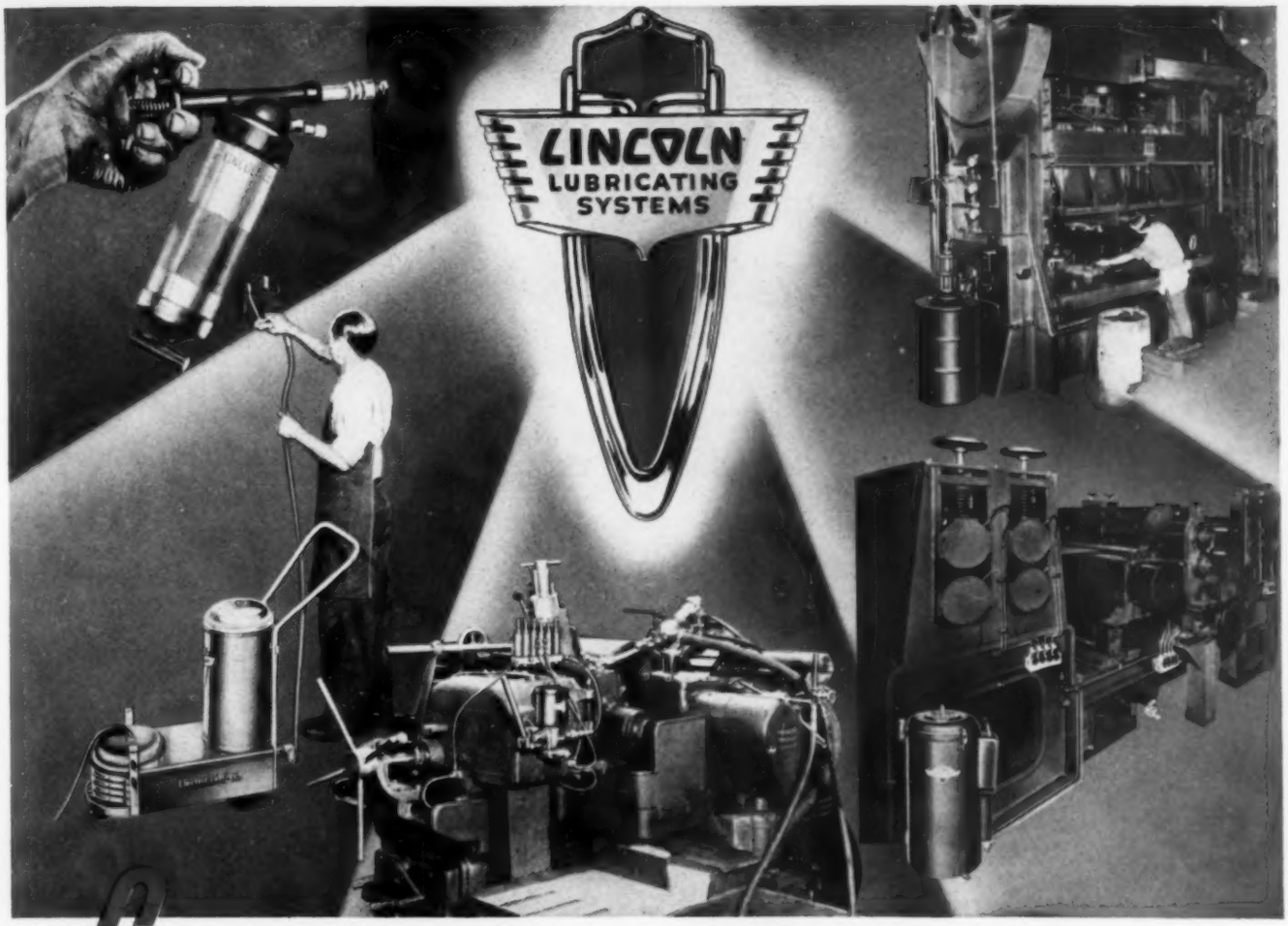

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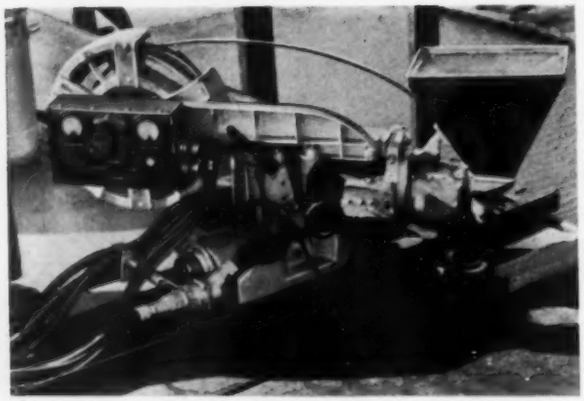
Right—The OXWELD C-45 blowpipe cuts steel up to 60 in. thick. This 30-in. cut through a 45-in. thick ingot took only 15 minutes.



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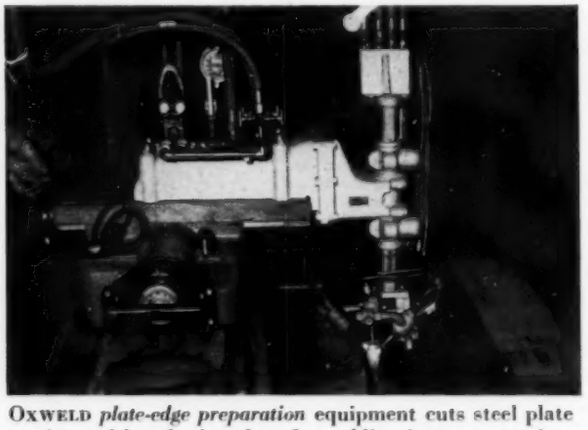

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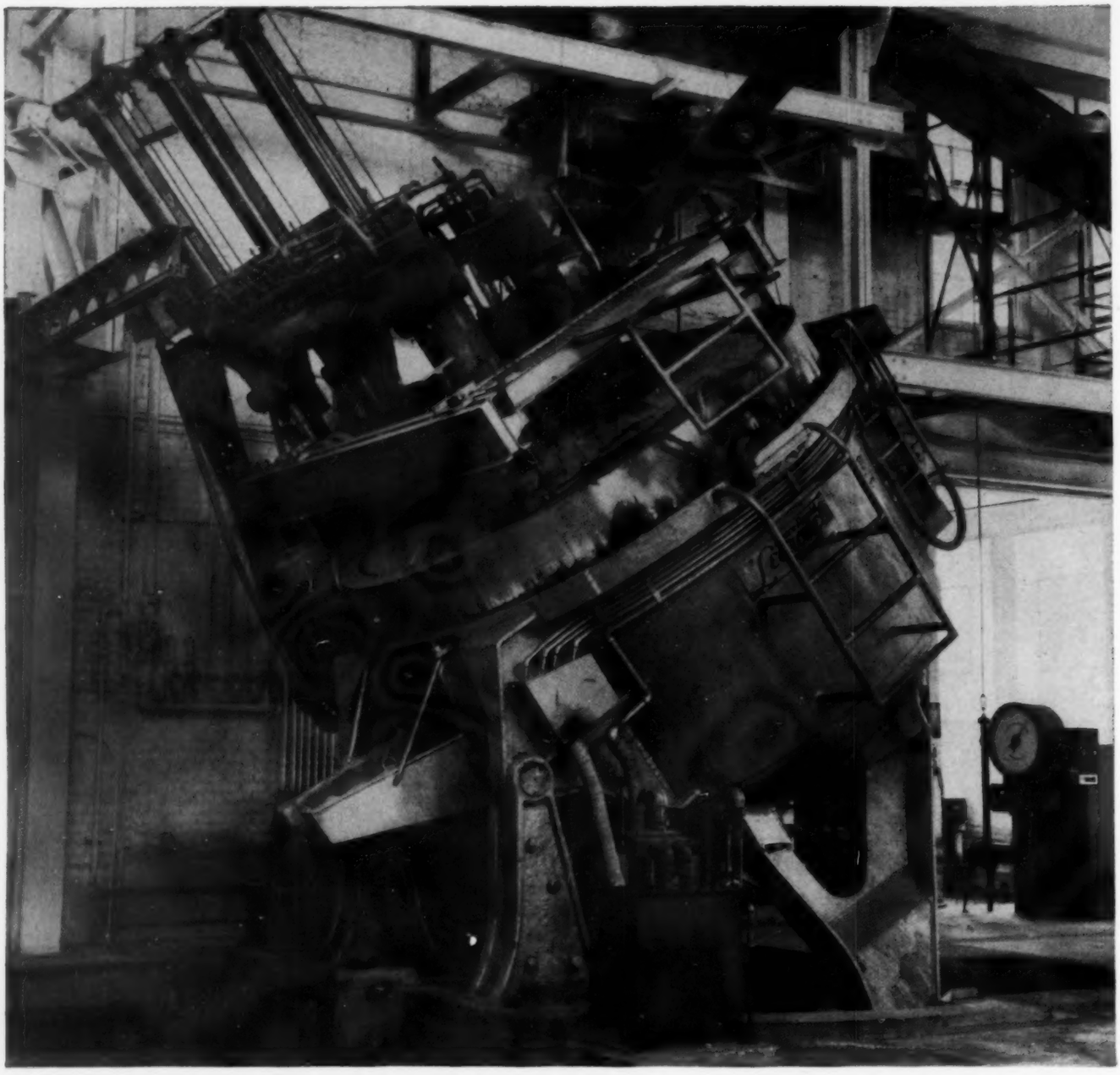

THIS SIZE PT Moore Rapid Lectromelt Furnace, located in a midwestern foundry, is pictured here in full tilt position which provides unusual ease in pouring. The Lectromelt PT has an hourly rating of three tons and melts up to six tons in a single heat. Its usual single turn foundry output is 24 to 28 tons. The PT is a topcharging furnace with counterbalanced electrode arm controls.

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ELIMINATING DEFECTS

Through Improved Rolling Methods

By J. A. TISCHBEIN,
General Foreman of No. 18 Rolling Mill
Jones and Laughlin Steel Corp.
Pittsburgh, Pa.

J. A. TISCHBEIN

. . . . changing pass design and procedure reduces defects due to seams, and increases tonnage and yield . . . .

▲ IN any manufacturing operation, whether it be the fabrication of small parts or the rolling of steel, the ultimate aim of any operating personnel is to produce their particular product more efficiently at lower cost and of better quality. In order to compete with the trade and to adhere to the stringent requirements that our customer's are increasingly demanding, it is evident that every effort must be put forth to produce a better quality product at a lower cost per unit or ton produced.

Pass design and rolling methods are highly technical and extremely controversial because of the many intricate pass and mill layouts, and particularly the opinions of the various operators. Not being a roll designer, I will therefore attempt to analyze only the methods and improvements that have, in my experience, helped to eliminate injurious seams and surface defects that are common to a 14 in. bar mill or mills of similar design.

Before digressing further, I would like to emphasize that a rolling mill is not a cure-all for other mistakes or ills in the making of steel, as some people would like to believe. Any operation, and especially the rolling of bars, shapes, and die roll sections, requires the best of materials that are available. This material, of course, in a bar mill, means good sound billets free of injurious defects. From the initial breakdown of the ingot to the finished billet size, extreme care should be exercised to produce a quality product. We should not depend on the scarfing or chipping beds to eliminate chemical or mechanical mistakes that can develop in the process of steel making, or the rolling out of the ingot to the desired shape or dimensions. Most seams are nothing more than cracks in the steel that are possibly due to weak areas that may have been set up by stresses produced by either heavy drafts, improper rolling or handling techniques. These must then be removed, at additional cost, on the reconditioning beds so that the finished product (bars, shapes, etc.) will be clean and free of any surface imperfections that might be detrimental to the ultimate product. This is not only an added expense to the manufacturers but also to the ultimate consumer, namely, the customer.

If the billets or material to be rolled are seamy and slivered, and a good quality product is desired, these defects then must be removed on the reconditioning beds before charging. As was stated at the beginning of this paper, and I would like to repeat again without being too repetitious, a rolling mill is not a "cure-all" for some other mistakes in the making and preparation of the billet. We can help to partially eliminate these seams and imperfections by correct elongation and reductions, but we cannot wholly repair what damage has already been done to the steel in the initial process of making the steel, and converting it to the billet sizes to be used on the rolling mills.

Proper size billets of the desired shape are extremely essential, so that the correct stock needed in the breaking down of the billet or bloom can be accomplished without encountering overfills that might lap over, or underfills that will not fill out. This over-lap will be retained in the billet in succeeding passes, and no matter how small the finished shape may be, a seam will remain as a result of the incorrect stock or turned down billet. See Figures 1, 2, and 3.

Whether it be a blooming mill or a rolling mill, we all can be guilty of mal-practice until we are able to find some method to improve our way of rolling. I would like, at this time, to recount an experience that developed during the early stages of the last war, which very clearly demonstrates what harm poor rolling practice

Presented before AISE Annual Spring Conference, Buffalo, N. Y., April 26, 1948

can do to good sound steel. As was the case with all mills throughout the country, we were producing a very large tonnage of shell steel. Our specifications called for the following chemical range. C 48/53, Mn 60/90, P 0.04, S 0.05, Si 15/20. We rolled this particular grade of steel from a 7 × 7 in. bloom, 17 ft 0 in. long, into a 3 in. round which was to be forged and further processed into 90 MM high explosive shells. In addition to the chemical and physical requirements set up by the Army, we found that it was necessary to produce a bar that was practically free of seams. The requirements were very strict and had to be adhered to in order to meet the specifications that the military personnel demanded. After rolling, and allowing sufficient time to cool, we would inspect this material in its entirety, and found that it would be necessary to hammer chip anywhere from 50 to 100 per cent of an entire heat due to cracks down the full length of the bar. This, of course, was very costly and necessitated the hiring of more men when labor was scarce, but most important of all, we were not able to expedite our shipments as quickly as the shell manufacturers required.

After a great deal of study, and I might add anxiety, we found that the same grade of steel that was being rolled into round corner squares of similar area dimensions, was being rolled and inspected with very few rejections of the type we had encountered on the 3 in. round size. We then compared our method of pass design and mill layout, and decided to formulate a new method of reducing and elongating the steel after the bar left the roughing mill. Since our squares and round corner squares were being reduced by a diamond and square method of reduction throughout the entire mill, we decided to design our passes for round reductions in the same general manner. Although the steel had a tendency to crack when rolled on our old layout, we discovered that when rolled in the diamond and square grooves, cracks and seams were hardly perceptible, and our rejections and reconditioning costs were reduced considerably. From this experience, we not only improved our rolling technique, but also furnished a better quality product to our customers at a lower cost to the mill. See Figures 4 and 5.

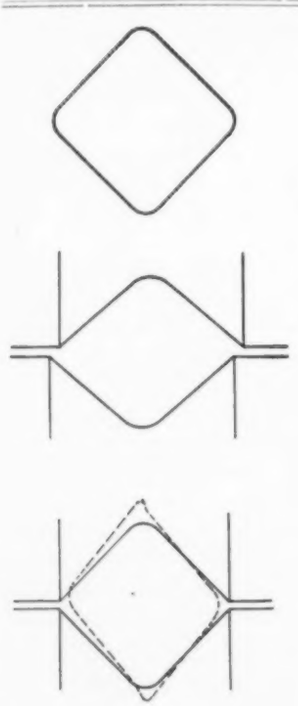


Figure 1 — When rolls are crossed in a diamond pass as is illustrated, or any other type pass, a serious lap condition can develop which will show up as a seam or seams in the finished product.

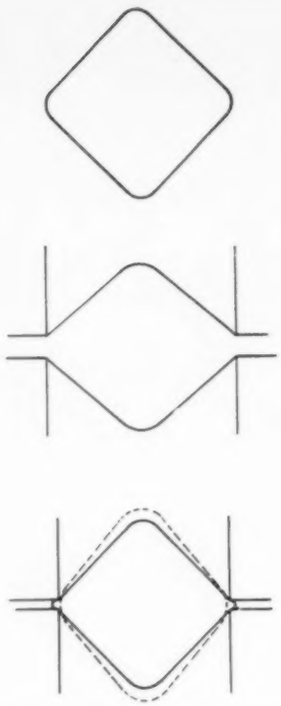


Figure 2 — Here is an overfilling of a pass caused by too much stock from previous passes. Since all the metal will not go into elongation, but will spread out over the collars of the roll, we find that in succeeding passes a lap will result, showing up as a seam or seams in the final product.

After this experience, we rearranged our entire layouts for rolling rounds, the range being $1\frac{1}{32}$ in. round to 4 in. round, and enjoyed practically the same general results. I am not attempting to say that by these changes we have eliminated all seams and surface defects, but we do know that we have improved our bar surface considerably, and have kept heavy seam rejections to a minimum.

From these improvements over a period of time, we have formulated definite ideas concerning the reaction of steel as to drafts, and particularly as to how the reductions should be made. A few of these are as follows:

1. Steel reacts the same way in a set of rolls as in an upset when hammered down. If there is nothing to hold the metal it will spread, and of course rupture any weak portions of that metal, thus causing cracks and internal stresses which result in seams. See Figure 6.
2. The periphery of the bar should be covered by as much of the pass as possible. This creates a more elongating effect when rolling, and thus reduces the seam in depth in the same ratio as the bar is elongated and reduced in area. The chances of a spreading effect are minimized, and thus eliminates what might be termed a wrinkling effect in the area where the metal is not supported by the pass. Note Figure 7.
3. Some grades of carbon and alloy steels can withstand much greater punishment, than, let us say, a high manganese and high sulphur grade. Extreme care must then be exercised in the handling of these grades that are susceptible to crackage and rupturing of the metal. We have found that those grades that crack and rupture open in one pass, are therefore lapped over in the succeeding passes, thus causing a surface filled with seams and a lapped over condition.
4. From numerous tests and upsets made, we found

that the seams, cracks, and overlaps would generally be on the two opposite sides or the four opposite sides. This can be seen very clearly on Figure 7 which shows where the initial harm to the steel occurred, and how the steel was lapped over and never given an opportunity to stay intact.

5. Seams and cracks in the billet or bar cannot be welded together regardless of how hot the billet may be heated. All that can be accomplished when rolling is either an elongation or spreading of the bar. We have found that by the process of elongation, we can make the seam more shallow and thus reduce in part the injurious effects that these surface defects might have on the finished bar, whether it be for forging, turning, or for cold drawing purposes, but they cannot be eliminated in their entirety, and only improved upon.

We therefore believe, from our experiences in the past, that no matter how well billets are prepared and the steel made, if the billets which are to be rolled are not handled properly and are subjected to too great and improper drafts, this preparation is of little consequence as far as the finished product is concerned. Atmosphere will not support metal from spreading, such as when a direct upset is made or an open pass is used, and we therefore believe it to be of prime importance that the bar or stock being reduced should be supported on all sides, insofar as is feasible.

This was readily seen not only from our own rolling experience, but also from an experience encountered by a large forging company, of which I am familiar, that had been having difficulty with their stock cracking and opening up when the forging was made. After considerable annoyance and time spent in trying to correct this unfavorable condition, they resolved to change their method of forging. After the change was made, their problem of crackage and high rejections due to their previous mal-practice was eliminated. Previously they believed that seams were causing the trouble. No doubt weak spots or areas were in the steel that was to be forged, and all that was needed to open them up was improper or harsh treatment in their forging operations. When this was eliminated, considerable delay time on their machines was reduced, and their yields were increased and a better product resulted.

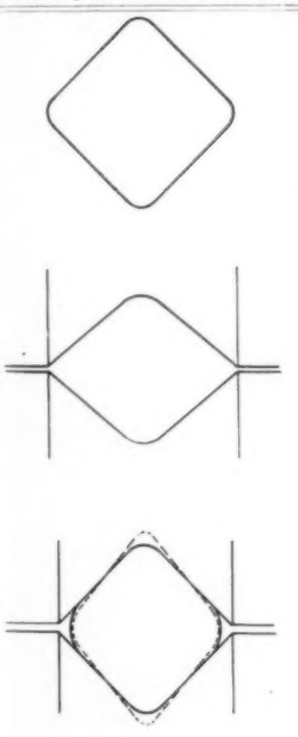


Figure 3 — This is the opposite effect to that described in Figure 2. By not having enough stock in the diamond pass to fill out the square we have an unfilling condition which makes it difficult to hold the bar in the pass.

Unfortunately even though passes and rolls may be designed to the best advantage of the mill, there is always the problem of the element of errors and mistakes made by the personnel in the operation of the mill. If the rolls are not set in line or are crossed, fins and overfills may develop, that in succeeding pass reductions will lap over and form seams or cracks in the finished bar. This overfilling of a pass causes the steel to spread between the collars of the rolls, and is often rolled down into the surface causing a surface crack or seam which might be detrimental to the product rolled. Unequal drafts, off size billets, ragging if too deep, and guide marks are conditions that must be corrected or eliminated to obtain a desirable product. This can be accomplished not only by proper design, but also by an intelligent and constant training program to facilitate the rolling of a saleable product at the lowest possible cost.

Of course, the knowledge of the requirements that the customer demands must be our guide at all times. Light surface seams or imperfections may not be detrimental to his operations, however, we believe it behooves all of us to work towards the ultimate aim of any steel manufacturer, to attempt to produce a product free of imperfections and harmful defects, whether they be internal or surface.

Years ago a bar of steel was not as rigidly inspected and tested, but due to the severe requirements set up by our customer standards at the present time, it is more imperative now than ever before to carefully study and analyze the making and rolling of steel products to satisfy the customer's needs and requirements. With the advent of magnaflux machines, magnetic testers, and various microscopic methods of determining defects in steel that cannot normally be detected by visual inspection, we must maintain the best rolling practice available and suitable to the mill. As stated before, we have by no means eliminated all surface seams and defects, but we do believe that since we have changed to a diamond and square method of reduction, we are advancing in the right direction.

To further help an improved surface condition, the installation of a hydraulic spray system has aided greatly to our bar surface, particularly on grades of steel that form a hard surface scale which is difficult to remove by mechanical means. With a diamond and square method of reducing a billet to its ultimate finished size, it is more difficult to break the scale, but we have found the hydraulic water system, when applied around at approximately 1,000 psi pressure, to be satisfactory. Our experience has been gained by the rolling of thousands of tons of steel for our various cold drawn mills, and by eliminating this rough injurious scale we have helped their pickling and drawing operations, and particularly their die life.

The hydraulic water system has not only improved the bar's surface, but the mill's roll life is prolonged, due primarily to the tough and hardened scale that is formed being eliminated before the bar enters the rolls. The

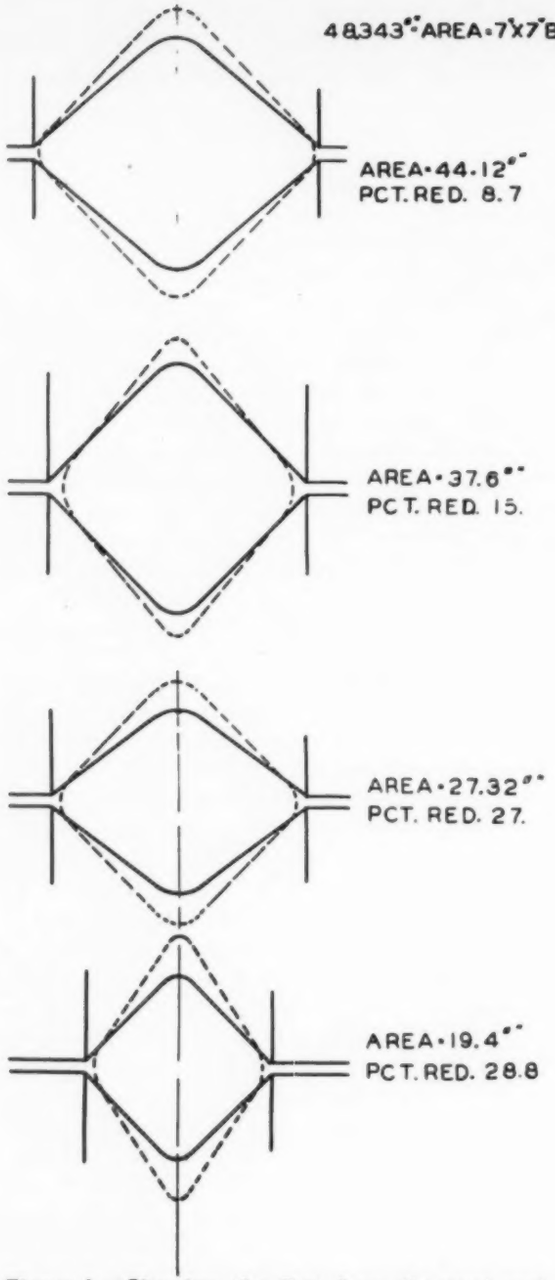


Figure 4 — Showing the first four diamond and square passes in the roughing mill train. These passes remained the same for the new layout as well as for the old system of reduction. The 4, 5 and 6 in. lines in the roughing mill are of similar design and also remained the same.

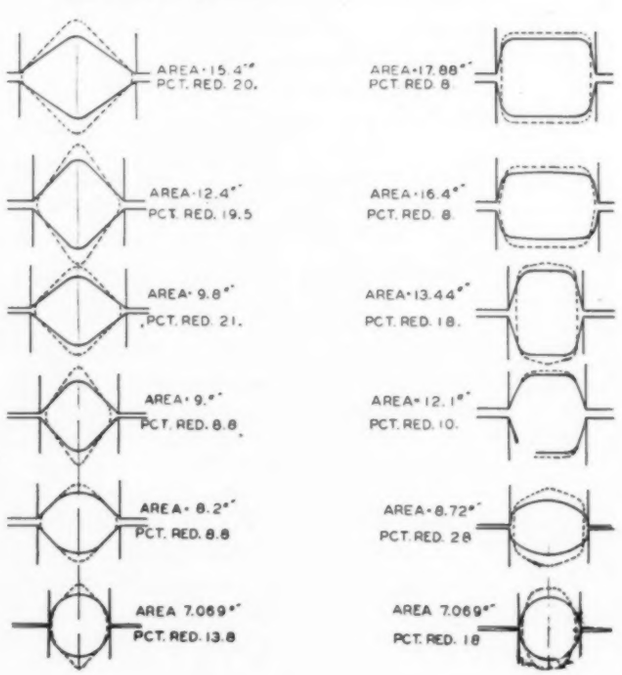
passes are kept cleaner and thus there is not the danger of a rough pass, especially in the roughing set, from damaging the bar, particularly on smaller sizes such as die roll sections, where a rough pass would show up very readily on the finished bar.

Of prime importance in obtaining a good clean surface on the finished section, is the care given to the rolls and passes. Like anything else, whether it be an engine or roll housing, rolls and passes do wear out and can deliver only so much tonnage before they must be dressed. It is poor economy to keep rolls in the mill for too long a period, when later roll dressing could not justify the extra tonnage involved. We can gain nothing in the over-all picture of operating costs if we permit this to occur. The passes will get too rough or out of shape and will not only cause trouble on the mill, but the product rolled will not be of the best quality and may result in rejections due to their unsuitability for the trade. Good maintenance of rolls and equipment will eliminate trouble that might be encountered later on that could cause slivers, seams or a rough bar surface. A dressing in time will not only save and prolong the life of the roll, but will also give a much more desirable section. This not only refers to the finishing and leader rolls and passes, but also to all other passes and rolls throughout the mill.

We are continually trying out new types of rolls, and with the help of the various roll men throughout the industry are striving to roll a better product at a cheaper cost per ton per pass. This is particularly true of die roll sections of light foot weight and thin gage. Due to the heavy work and lower finishing temperature of the bar, our passes wear out much sooner and necessitates too many pass changes. Conditions, such as these, lower the mill's efficiency and greatly increases its operating cost.

In addition to pass design, proper preparation and rolling of the billets to be processed, reheating of the blooms is of prime importance in obtaining a good surface on the finished product. Naturally there are limitations as to what a furnace can heat and the tonnage the operating personnel might desire. It is therefore poor economy to try to produce more tonnage than the fur-

Figure 5 — Comparing the new layout of diamond and square reduction with the old oval and square. Instead of the metal going into spread as it did on the oval and square method, more elongation was accomplished due to enclosed passes. By working the metal more uniformly and preventing a spread of the metal, seams are kept to a minimum. Previously a great deal of damage was done in the leader pass because of an excessive reduction and the type of reduction. By changing the percentage of reductions, as shown on the comparative drawing, the finished bar surface was greatly improved.



ace or furnaces are capable of heating, if the final product suffers due to insufficient temperature.

We have found that if the billets are heated slowly and are not subjected to an intense initial heat, we have a much better bloom with which to work. This is especially true with certain grades of steel that have a tendency to crack or break when first charged in the furnaces, such as high manganese and high carbon steels which are susceptible to crackage and cannot stand an intense initial heat. During the war, to help counteract this crackage condition, particularly on the corners, we extended the back part of our furnaces about seven feet. This not only helped our surface conditions, but also improved our tonnages on larger sections, because due to this preheating, we were able to soak the billets longer and the heat penetrated the blooms, thus giving a more uniform heating condition. Naturally with a uniform heat throughout the billet, it is much easier to control the section to be rolled, and the possibility of a spreading of the metal is decreased to a minimum, especially

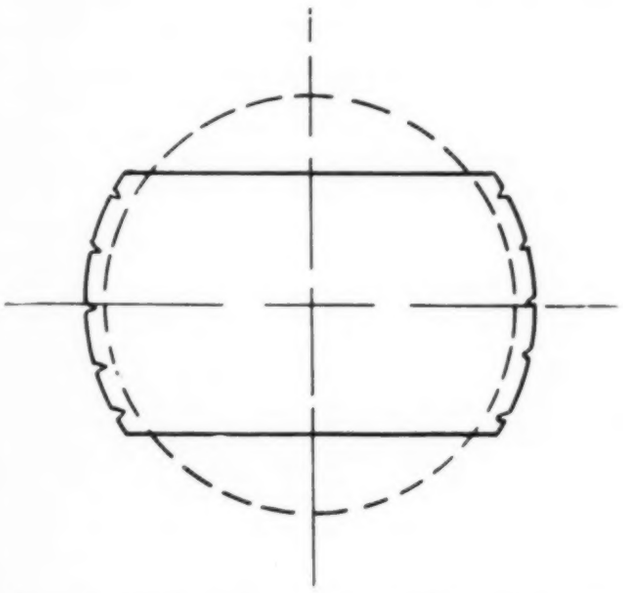


Figure 6 — Cracks resulting from internal stresses eventually give seams.

where an elongation is needed to reduce the bar in area to the proper and desired stock needed for succeeding passes. If there is a cold spot on the end or middle of the bloom, the metal reacts differently in that particular area and has a tendency to spread, thus causing an overfill that could and sometimes does lap over in the next pass. This is especially true, if it is necessary for the mill to be wide open to obtain the desired stock. As has been previously stated, we have found that the diamond and square method of reduction keeps this spreading effect to a minimum due primarily to the periphery of the bar being surrounded and covered by the pass at all times, thus creating more elongation than spread.

There are of course limitations as to how hot the billets can be reheated without sticking or burning the surface. However, we have found it to be desirable to heat the steel to be rolled to as high a temperature as possible without creating the aforementioned conditions. Of course, this has been accomplished by a trial and

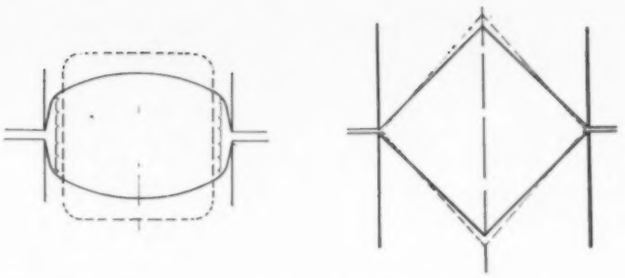


Figure 7 — The pass on the right is the better because more of the periphery of the bar is covered by the pass.

error method but, from our experiences we have learned that all steel cannot be heated the same and consequently presents various rolling problems previously discussed. If the steel is well heated and soaked it is more malleable, is much easier worked and the finished surface is of much better quality than if the steel was not heated to a proper rolling temperature. This, of course, varies but our experience has been to bring the billets out of the furnace at around 2100 to 2200 F when rolling common grades of carbon steel. Better control of heating temperature has been accomplished by the installation of automatic controls which benefit the heater in obtaining the proper rolling temperatures. We have also found since the installation of a pyrometer put in after the third roughing stand, that our rollers are more alert as to steel temperatures and this also facilitates contact with the heater as to what temperature they might require. Improvements such as these not only make for improved rolling, but give the customer a better product as far as section and surface is concerned.

I might also add that through improved heating, particularly on smaller sections, roll life is better maintained because the better the billets are heated, the less the wear which will occur on the rolls. Consequently, the passes are kept smoother and the finished bar surface is of higher quality. Cold billets or bars are extremely harmful to roll passes and cause excessive wear which is very costly to the mill because of roll dressings and new roll requirements being made before the maximum roll life is obtained.

In any discussion on improved rolling methods to help eliminate seams or injurious surface defects, a subject that cannot be overlooked is the use of guides in a rolling mill. There is a difference of opinion among mill men concerning types, makes and uses, just as in pass design, which is highly controversial. However, when rolling rounds and squares, we have formulated certain ideas concerning guides best suited to our particular mill, which as stated before is a 14 in. bar mill. I would like at this time to pass along information gained by studies that we have made.

Of course any guide study or improvements made must limit itself to that particular mill in question and the type of product rolled. Special shapes are more difficult to control and are therefore a subject by themselves. We have found when rolling rounds that the design in which the least amount of work is done by the guide is the best. If guides have to be adjusted to the shape of the bar, to hold it from turning over in the pass,

there is a greater danger of guide cutting and mill shearing than if the guides were just used to lead the bar in the pass. This problem naturally ties in with the correct pass design mentioned before, and therefore can be remedied by proper pass design.

Before changing to a diamond and square method of reduction and pass design, we were continually working under the handicap of possible mill shearing and guide cut due to the necessity of the guides having to be kept tight since the shape of the bar and pass made the bar have a tendency to lean or turn down. Since changing to our present method our passes help hold the bar more efficiently, and consequently it is unnecessary to have guides set too close. This is especially true in our roughing stands where we have installed hanging guides for the top, and a solid plate for the bottom passes. We not only strip the bar from the roll easier, but shearing in our roughing mill has been reduced to an extent that is hardly noticeable. This elimination of guide cutting and mill shearing means that a better product is obtained, since the shearing and cutting is not in the finished bar in the form of laps or rolled in shearing. We also eliminated the same condition in our leader and finishing passes by gradually changing the degrees in the guide itself. By the use of hardfacing alloys we also found the bearing surface was much improved, and that there was less tendency for shearing and a better bar surface resulted.

Although, as stated in the beginning of this paper, a rolling mill is not a "cure-all" for previous ills in the manufacture of steel and it also must be remembered, as I have attempted to illustrate, that a rolling mill can also be guilty of improper pass design and rolling technique. I hope, however, that the illustrations presented, and the experiences recounted throughout this paper, will give information helpful in the operation of mills of similar design. We are continuously making more studies concerning our pass and roll layout, and hope in the near future to even further the improvement of our product.

DISCUSSION

PRESENTED BY

G. S. MICAN, Division Superintendent of Rolling, South Works, Carnegie-Illinois Steel Corp., Chicago, Ill.

A. G. ERICSON, Chief Engineer, Homestead Works, Carnegie-Illinois Steel Corp., Munhall, Pa.

E. C. THOMAS, Atlas Steels, Ltd., Welland, Ontario, Can.

J. A. TISCHBEIN, General Foreman of No. 18 Rolling Mill, Jones and Laughlin Steel Corporation, Pittsburgh, Pa.

LOUIS MOSES, Superintendent, Rail and Roll Department, Bethlehem Steel Co., Sparrows Point, Md.

GEORGE PIMLOTT, Superintendent Roll Shop, Republic Steel Corp., Corrigan-McKinney Division, Cleveland, Ohio

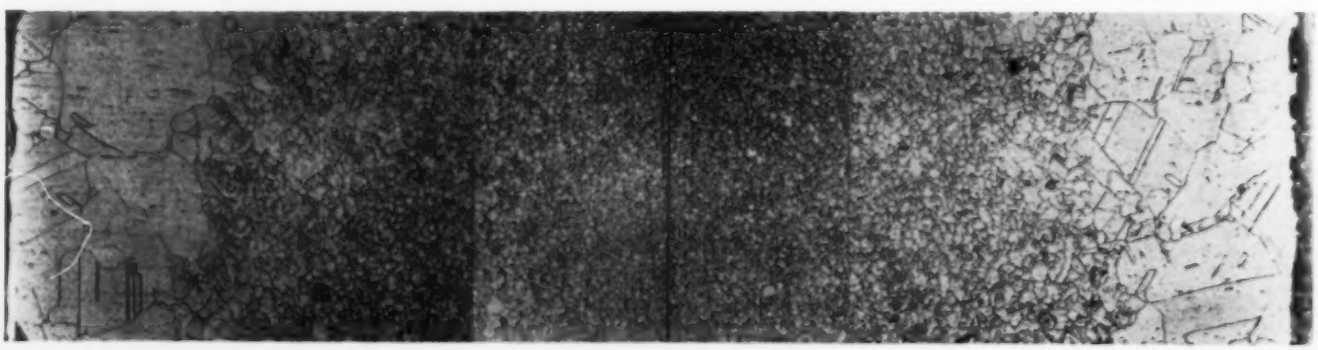
G. S. Mican: My comments will best be illustrated by a few illustrations. Figure 8 merely shows a standard upset test, originally a half inch round, inch and a quarter high, type 304 stainless steel, which was upset from the 1¼ in. height to a 3/16 in. thickness, in one hammer blow. A difference in grain size from the outer periphery to the interior shows a deformation gradient that I will correlate with several illustrations that follow.

In Figure 9, you will notice the corresponding gradient from the outer top and bottom surfaces to the interior on this illustration, which was originally a 3 in. diameter cylinder, six in. high, built up from ½ in. disks. You will also notice that points on the outer peripheries of the disks, as compared to points on the inner portions, tend to climb to the two contact surfaces with the dies.

Figure 10 shows a like cylinder, deformed to about 1¼ in. thickness. The original was the same size and of the same composition as the one shown in the prior illustration. You will notice that the disk peripheries have progressed to form a portion of both the top and bottom surfaces. You will also notice that in progressing, particularly near the corners, as these disks approach contact with the dies, there is tension in the outer peripheries acting to separate the disks. You can readily picture that if a sub-surface defect exists at those points corresponding to disk junctions, there is a tendency to open up these weaknesses into seams at the surface.

Figure 11 shows a bloom which has been deformed,

Figure 8 — The photograph shows the difference in grain size throughout a ½ in. round subjected to the upset test.



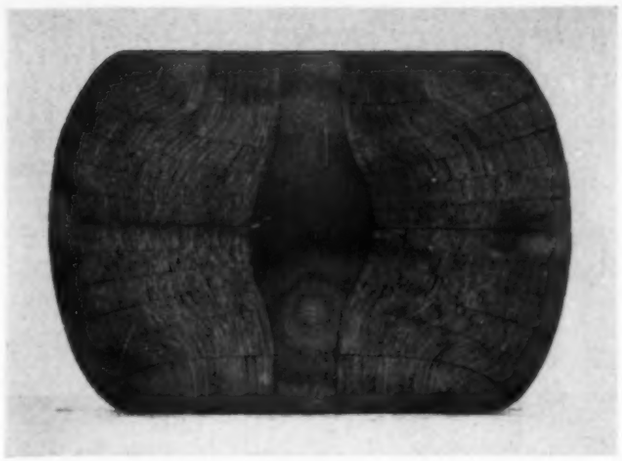


Figure 9 — Cross-section of upset test performed on a laminated cylinder constructed of disks ½ in. in thickness, 3 in. in diameter, and 6 in. in height, the disks being held together by a ½ in. rod inserted through the center. The cylinder was heated to about 2200 F and compressed on the blacksmith shop hydraulic press. The disks were cut from a 3 in. round, and when grouped to form the cylinder, the individual disks were rotated on the holding plug so that the original as-rolled flow lines would not coincide. Photo indicates that the flow lines of the upset test were rendered discontinuous as a result.

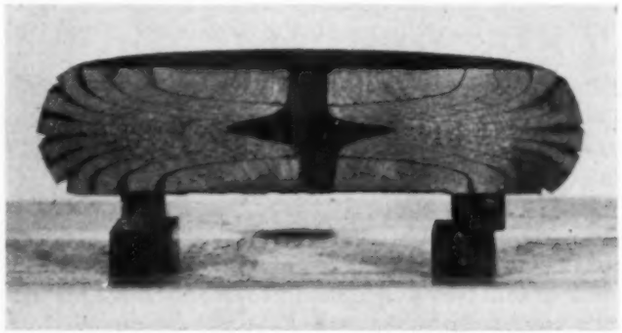


Figure 10 — Cross-section of an upset test on a laminated cylinder 3 in. in diameter and 6 in. high. The cylinder was constructed of ½ in. disks cut from the same 3 in. diameter shaft and retained by a ½ in. plug inserted through the center. The disks were rotated on the plug before upsetting to determine if the flow lines would be rendered discontinuous by so doing. The cylinder was heated to about 2200 F and upset on the blacksmith shop hydraulic press.

originally built up from half inch plates to a 6 × 8 × 70 in. long bloom, rolled on a 30 in. universal mill with no edge work. Free spread was allowed. The bottom portion shown is the bottom part of the bloom as rolled. Notice that the bottom plate spread is practically nothing while the interior plate spread is approximately 2¼ in. You will notice likewise that the spread of the edges was identical with the spread of the edges of cylinders which were deformed under a press. In other words, any tendency towards seams which already exist, subsurface defects or edge weaknesses, have a tendency to work to the edge of the surface and open into longitudinal seams.

These illustrations indicate, from a different viewpoint, the same conclusions arrived at by Mr. Tischbein. Free spread is conducive to the formation of longitudinal seams. Mr. Tischbein pointed out that surface quality was improved by a change from an oval to square to a diamond to square roughing formation. He correctly concluded that the prior formation was more severe with respect to free spread in the passes.

A. G. Ericson: With the shortage of steel confronting us today, we should be ever mindful of our rolling practice and strive for higher yield. The author has pointed the way and if we employ some of his ideas many thousand tons of steel could go to market instead of to the scrap heap.

In the figures that Mr. Mican presented to us it showed clearly how necessary it is to support the steel all around its periphery in rolling. It demonstrated to us where we have no support defects increased. It is important, therefore, that we give proper attention to guide and roll design.

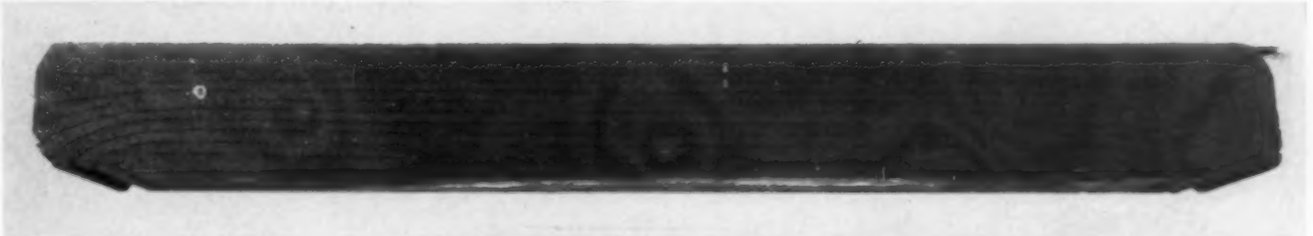
In conclusion we should always be on the lookout to improve our yield, it is one of the most important factors in our operations.

E. C. Thomas: What would be the minimum hydraulic pressure you could use to remove scale produced in the furnace, from the billet before it enters the mill?

J. A. Tischbein: As stated, we have found that a thousand pounds pressure has been satisfactory, however there is a certain amount of line loss. We have five stands where hydraulic sprays are located and the pressure at the stand furthest from our pump is probably about 850 pounds, which we have found to be satisfactory. Of course when rolling steel of a high alloy content, more pressure is needed, as the scale has a tendency to stick to the billets and is difficult to remove.

Louis Moses: Bar rolling is accomplished by various

Figure 11 — Cross-section from laminated bloom that was rolled in the 30 in. universal plate mill without using the vertical rolls, and without turning. The bloom was constructed from ½ in. x 8¼ in. plates, 70 in. long. Twelve of these plates were packed together to form a bloom 8¼ x 6 in. in cross-section, the plates being secured by welding along the sides and on the ends. After heating to about 2300 F in the furnace, the bloom was rolled into a 1 in. plate with the following drafts: ½, 1, 1, ¾, ¾, ½, ¼ and ¼ in. When rolled to size, the plates on the top and bottom surfaces were found to be 1/16 in. in thickness, and the plates in the middle about 3/32 in. It will be noted that the bottom plate virtually had no transverse spread, whereas some of the center plates had spread 2¼ in.



schemes but none can be said to eliminate absolutely and completely all of the seams which may be present in the billet or bloom surface. As accompanying each instance will be found a mill layout which either works a billet into a bar in the fewest number of reducing passes or permits a greater number of passes as is required by the described square to diamond method.

Excepting the rolling of structural and other shapes, and confining our discussion to bar rolling, the heaviest work when relatively applied to the vertical central zone creates a maximum amount of elongation to the whole bar with a minimum amount of spreading action. This was found to be the case in a particularly difficult rod mill situation with which the writer is familiar. Results then obtained within the range of such roughing stand application of the square to diamond scheme leads to a full concurrence in the effectiveness of the method.

Some years later it was a privilege to view the results of the work of this same company's roll engineer who most convincingly demonstrated on one hand the damaging action of a conventional and widely used scheme and on the other the advantages toward seam reduction of the square to diamond scheme described in the paper. He had located a length of a particularly seamy billet

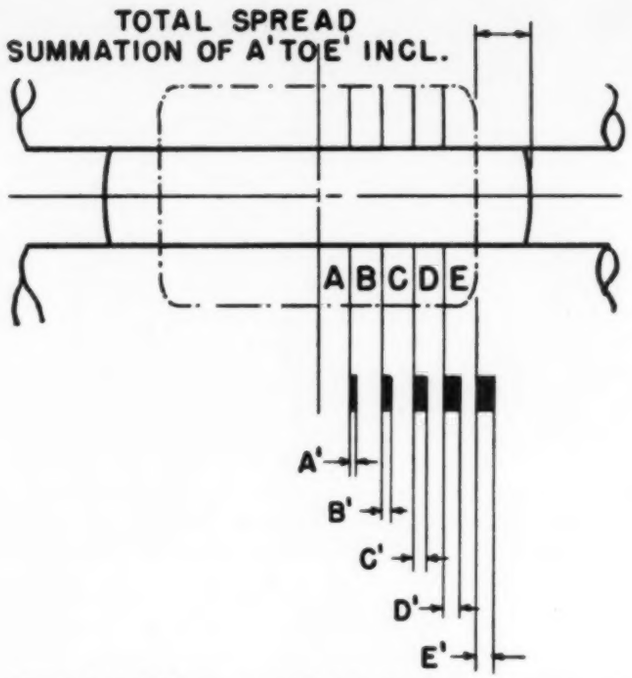
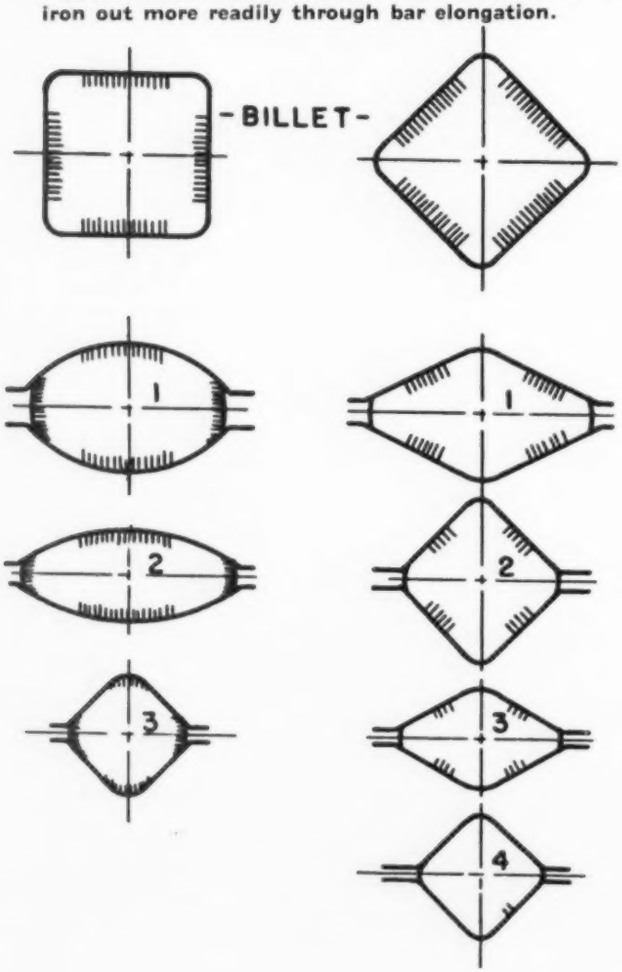


Figure 14 — With every ordinate tending to create an equal amount of spread, those nearest the center are variously restricted by face friction.

Figure 12 (left) — The seams in the billet surface are concentrated into the corners as laminations with probable scale inclusions.

Figure 13 (right) — Transverse disturbance is minimized. Original defects are held in their relative locations and iron out more readily through bar elongation.



in which seams were practically similar on all four sides, and had cut the billet into short pieces. Each of these pieces were rolled down to the same sized square by employing the two schemes shown by Figures 12 and 13. Cobbles were taken from each pass, upset and etched. The initial surface incidence is schematically illustrated on both by groupings of lines on the cross-section of the entering billet.

It is shown in Figure 12 that as the bar is reduced in the two oval passes No. 1 and 2, the system of seams occurring in the vertical faces of the billet tend to fold upon themselves and become compressed into a narrower and laminated band at the roll parting of No. 2 pass. No change has occurred to the top and bottom surfaces except shape on which the original system of seams is slightly altered by spread. But when the oval is turned into the succeeding No. 3 square pass the same folding tendency occurs at the roll parting. The seams have been transferred from their original locations on the flat sides of the billet to the corners of the rolled square, and only partial elimination has occurred.

Figure 13 shows the entirely different effect on surface fibres which occurs in the square to diamond scheme. The billet was entered on its corners into the first diamond pass. The seamy regions are confined to their original relative positions. There is no folding tendency to bring neighboring and individual seams closer together into a state of lamination. The elongation conferred (in total the same as in Figure 12) has in like proportion reduced and ironed out the depth of each individual seam, so much so that only one side of the rolled square exhibited two faint seams with virtually clean faces on the other three.

It will be noted that one more pass is used to accomplish this result, due to the smaller amount of work per pass possible with this type of groove.

Sideways distortion of fibres, as accompanied with

spreading action, is lessened in the Figure 13 scheme through the heaviest work being applied along the vertical center-line and least at the horizontal extremities. Except in the last pass of Figure 12, the reverse of this is true, with the opposing characteristics subject to analysis. In my paper, "The Flow of Steel Between Rolls," (AISE Proceedings, 1938), it is stated:

"We explain spread as being due to the bar seeking escape in the direction of least resistance. Within limits of the total width, spread manifests itself at every point across the section with the respective increments being greater at the edges than at the middle. Perhaps this can be made clearer by Figure 14, which is necessarily shown to an exaggerated scale and divided into five ordinates at one side of the center line. The friction between the bar and the roll, as measured across from E to B prevents ordinate A from spreading more than is indicated by A'. The face friction E to C is less in amount and thus ordinate B may spread to amount B', which is greater than A'. In any number of ordinates this action is cumulatively greater as the edge is approached and the summation of all of them is the total amount of spread induced."

Referring again to pass No. 1 of Figure 12, the work distribution across the pass is least at the center line and greatest at the edges, this being characteristic of squares entering ovals. Keeping in mind the influence of face friction, this condition obviously creates maximum spread and sideways disturbance, either of which are conducive in retention of original surface defects. But the reverse of this is true in Figure 13 and the work application, through reducing sideways disturbance, allows for as complete an ironing out of defects as is possible.

Under the same principle the use of oval to round passes is even more advantageous and is frequently used within the limits of drafting imposed. The contour of a round groove creates less opportunity for roll bite and beyond the general vicinity of a 2 in. circle, the amount of applied work in an average sized bar mill is even less than with diamond to square passes.

The fullest advantage of the square to diamond scheme embraces the initial entry of the billet on its corners. This does not present too much of a problem with single strand operations but is presently a difficult one to solve with multiple stranding.

Square to diamond passes are correctly termed "total enclosure" passes. By this is meant that along with all the above the entire perimeter, sans parting height, is in contact with the groove walls as contrasted to rectangular box passes with the sides relatively open. It is futile to compare the steels of years ago with those now produced but it may be said there are less inclusions and the product is generally cleaner today. At any rate it was at one time rather difficult to impart a good surface to rounds, say for seamless tubing, and often impossible with box passes. As a result the gothic pass was utilized which, despite its slowness of about 20 per cent reduction in area per pass, conferred the desired results to the surface. Figure 15 illustrates three passes of this system. It will be noted that a modern mill, mechanized for bar turning, successfully employs this method for seamless tube rounds. Using reconditioned blooms it is stated that there is a minimum of chipping or scarfing on the rolled rounds. This is mentioned as being another instance of total enclosure passes.

George Pimlott: In diamond-square methods, is that a true diamond square or is it a gothic, and will that remain the practice in all J & L mills or just this one particular group of mills?

J. A. Tischbein: I can answer for our particular mill. It is a diamond-square reduction throughout and, as I said before, we have incorporated diamond-square throughout our entire train in all sizes ranging from $1\frac{1}{32}$ in. round or equivalent to $4\frac{1}{32}$ rd. As to what will be done throughout the corporation I am not in position to say.

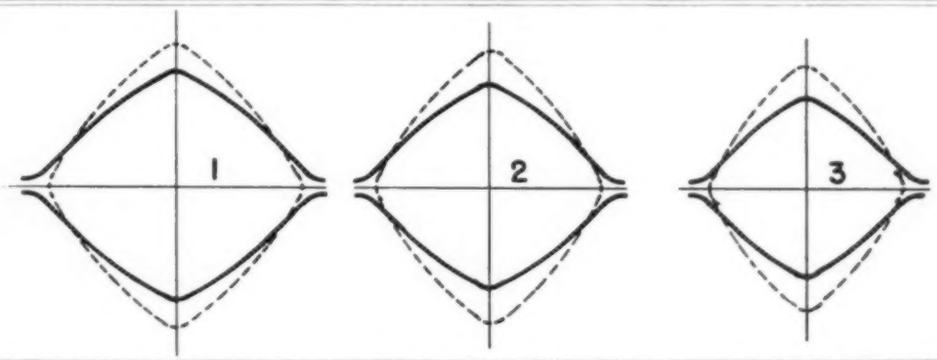


Figure 15 — Typical Gothic type roll grooves in which maximum coverage of the bar's perimeter is accomplished.

George Pimlott: What will be the effect on tons per hour from a change from an oval-square to the diamond-square?

J. A. Tischbein: It increased our tons per hour. As I mentioned before when rolling 3 in. rounds for shell blanks during the war, we were having considerable trouble with seams and cracks which necessitated a considerable amount of chipping on the finished bar. In fact, we even stuck the billets in the furnace due to excessive heating, thinking we had to heat them hotter in order to keep the seams or weak portions of the metal from rupturing open. We changed to a diamond-square method and were able to roll much greater tonnage with an average temperature and a better bar surface resulted.

George Pimlott: What effect did this diamond-square total enclosure have on production for cold drawing? I am speaking of surface not of seam, just of surface effect for cold drawing?

J. A. Tischbein: Seam and surface rejections were decreased to a minimum at our cold drawn departments. This of course helped their operations and also increased their yields. By the use of the hydraulic sprays, very few rejections are encountered due to pitting or similar defects.

STEEL MILL TRANSMISSION

▲ THE modern steel mill is entirely dependent on electric power in every phase of its operation from the ore dock to the shipping room. The importance and magnitude of electric power used in steel mills has steadily grown from around the turn of the century when it was first used for large main mill drives to where the iron and steel producers are the second largest users of electric power in this country. The total estimated consumption of electric power by this group for 1947 is about 15 billion kw hours. Steel mills are large producers of electric power as well as large users. There is approximately one million five hundred thousand kilowatts of installed generating capacity in steel mills. The electric generating capacity of many individual steel mills is larger than in a great number of utility systems.

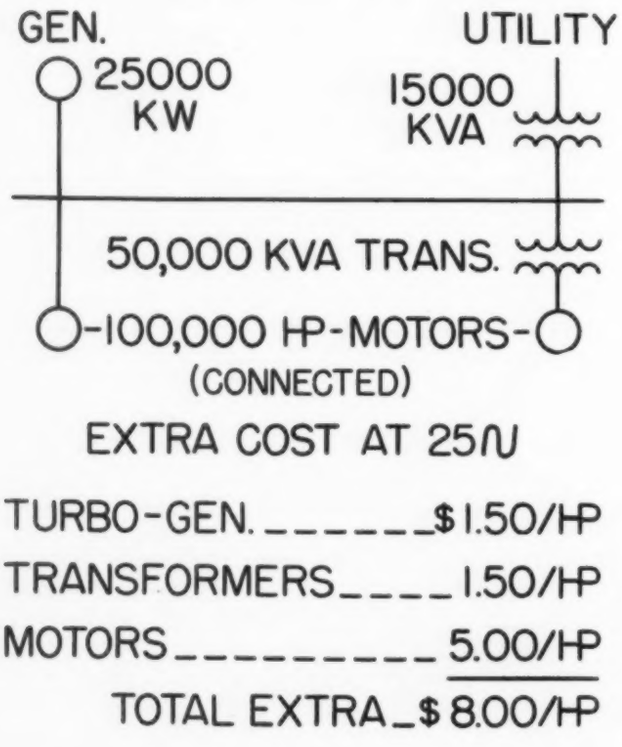
There are certain peculiarities of the electric loads and power systems in steel mills. First of all, a major portion of the load consists of very large motors of several thousand horsepower each. Secondly, most of the load is usually concentrated in a relatively few spots through the mill such as at mill motor rooms. The loads imposed by the mills are of a highly fluctuating nature, running from practically zero while the mill is idling up to a peak of several thousands of kilowatts when a piece of metal is going through the mill. Last but not least, 25 cycle systems are widely used.

In mills having blast furnaces there is available from the blast furnaces a large quantity of combustible gas. This represents very low cost fuel which can be burned in boilers to generate steam to drive turbine generators to make low cost electric power.

These peculiarities of steel mill loads and power systems bring about certain problems in the design of power generation conversion and distribution systems

Presented before AISE Pittsburgh District Section Meeting, January 12, 1948.

Figure 1 — There is a premium of $8.00 per hp when a 25 cycle system is used instead of a 60 cycle system.



. . . . since the cost of generating equipment has increased much more than that of purchased power, it may be more economical to purchase power than to install additional generating equipment in marginal cases, unless local fuel or steam conditions dictate otherwise . . . .

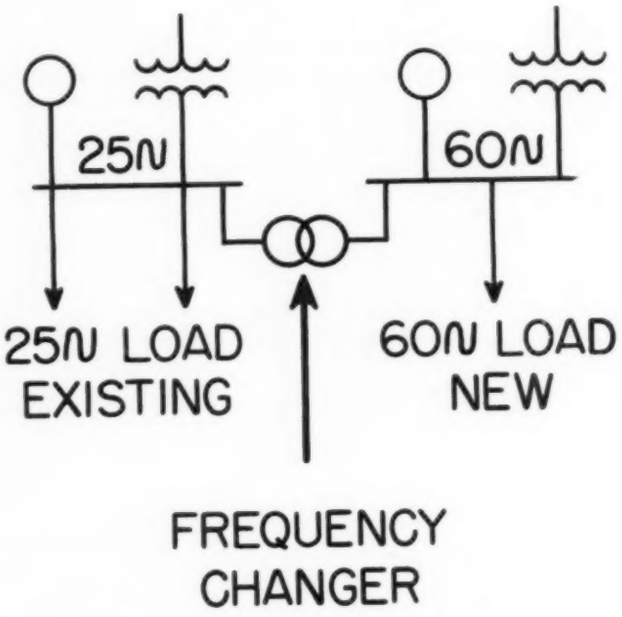


Figure 2 — When sixty cycle equipment is put in, it is advisable to design the system so that power can be used from an independent 60 cycle system or through frequency changers from the 25 cycle system.

which are not found in other industries. It is the effect of these peculiarities on the design of the power generation and distribution system that will be discussed in the following paper.

POWER GENERATION

In general, an industrial plant can only afford to install their own generating facilities when one of or a combination of three conditions exist:

1. Inadequate power available from utilities.
2. Large amounts of process steam required.
3. Low cost by-product fuel available in sufficient quantities.

Steel mills generate a large amount of power for the

POWER GENERATION, AND DISTRIBUTION

By D. L. BEEMAN, Manager
Industrial Power Division
General Electric Co.
Schenectady, N. Y.

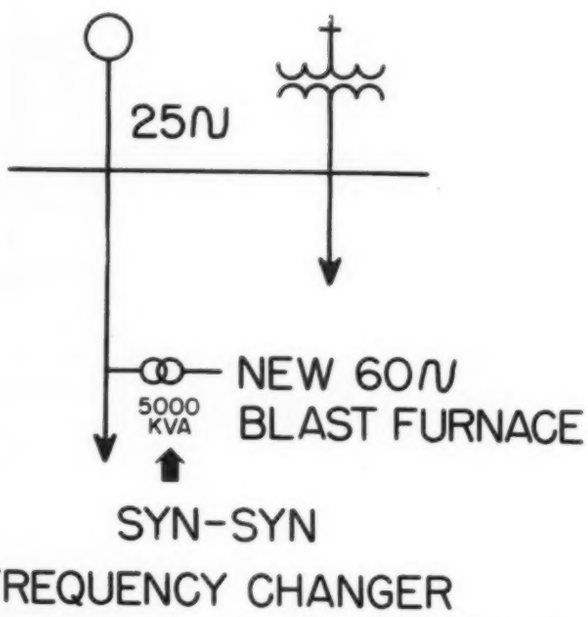


Figure 3 — Small loads can often be best handled by a frequency changer.

latter two reasons. Some process steam is required in the manufacturing processes. This alone would justify only a relatively small generating plant in a steel mill.

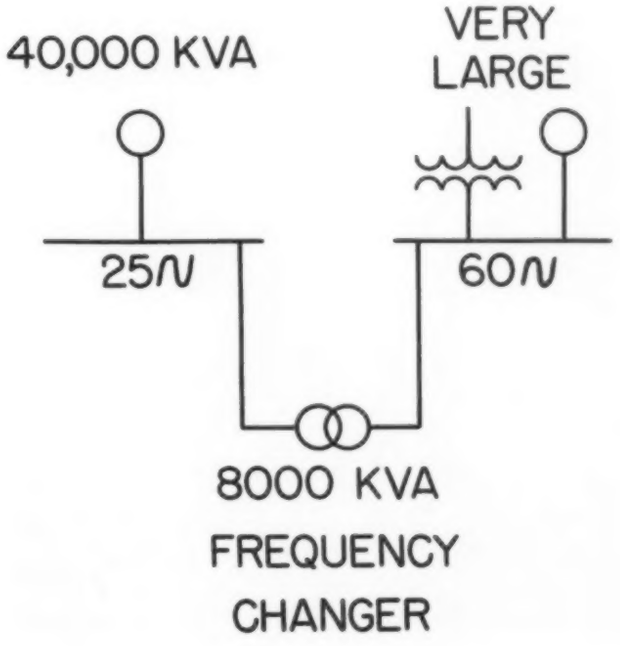
The basic reason for installing power generation facilities is to utilize the blast furnace gas which is left over after all heating requirements have been satisfied such as heating of open hearth soaking pits and reheating furnaces and sufficient steam has been generated to run the blast furnace blowers. There are to the writer's knowledge no developments which are going to change this picture in the foreseeable future.

Since it is difficult and often impractical to exactly balance the electrical demand with the supply of blast furnace gas, it has been a practice in some cases to burn coal under the boilers when the supply of gas was below a certain level. This means that there is certain generating capacity in a steel mill which is of a "marginal nature." It is this "marginal" area which requires scrutiny from an economic standpoint. It may be that today with greatly increased costs of plant facilities and coal that it would be more economical to install generating capacity only to the extent that it can be fully utilized and supplied all the time with blast furnace gas. The rest of the power would be purchased rather than generated. In other words, it may be more economical today to purchase a higher percentage of your power requirements than in the past.

A second factor in the economics of power generation particularly with the higher cost of power facilities—"Is it better to invest the money I have in new steel mill facilities or new power house facilities?" It may be better judgment in these times of rapid expansion of steel mill facilities to still further increase the percentage of electric power purchased. There can be no general rules drawn which you may apply in your individual case. Each case must be studied in view of local conditions and plant operating practices.

There are certain trends which are of interest to the power engineer when planning any facilities including a power plant. The cost of steam-electric generating plants in steel mills has in the past 7 or 8 years gone up from about $100 a kw to around $200 a kw. The basic cost of electric power purchased from electric utilities has not increased and in some cases has decreased during this period. For example, one weekly magazine shows in their cost of living index that electric power cost has dropped from 0.99 to 0.92 since 1939. However, where coal clauses are in effect, the price of electric power purchased has increased due to the increase in the cost of coal. The increase in the cost of coal would tend to increase generating costs, too. That, of course, depends upon whether the cost of blast furnace gas to the power generating plant is pro-rated according to coal costs.

Figure 4 — The frequency changer for a 25 cycle system having 40,000 kva generating capacity should at least have an 8000 kva rating.



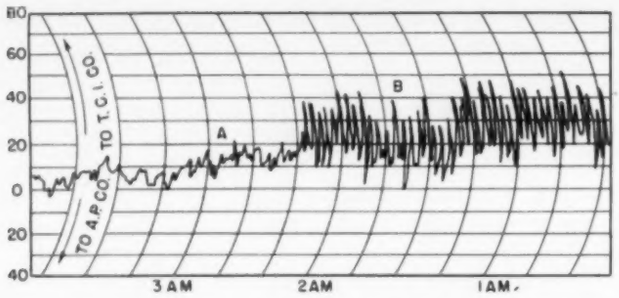


Figure 5 — This is a typical wattmeter chart of the power supply to a hot strip mill. Portion A shows the mill during shut down, and Portion B shows the mill during operation.

STEAM PRESSURES AND TEMPERATURE

The trend in steam pressures and temperatures has been continually upward. Plants are now being installed to operate at 2000 psi or above and 1000 F or higher. These ultra high pressures and temperatures are used to increase efficiency and reduce overall cost of power generation. In utility systems where such turbines can be used for supplying base load and operated at full capacity 24 hours a day, ultra high pressures may be economically sound. In steel mills the turbine sizes are smaller, usually not above 25,000 kva and not all of the turbines can be loaded up to their rating 24 hours a day. These factors in conjunction with lower cost blast furnace gas for fuel tends to make the medium steam pressures and temperatures rather than ultra-high pressures and temperatures more attractive to steel mill service from a first cost standpoint. However, on the other hand, it is not usually sound practice to select the lowest cost plant which is usually the lowest pressure plant because within a reason a very small increase in plant investment will result in a substantial increase in efficiency. Furthermore, the life of a steam generating plant is 30 or 40 years at least and during this long period of time there may be changes in fuel conditions which will require more expensive fuel to be used. If such is the case, the higher pressure temperatures will pay for itself in a very short time. This has proven to be true in many industrial plants in the last few years.

As a rough guide, the approximate relative cost of generating plants at various steam pressures and temperatures is given in Table I. In actually selecting the steam pressures and temperatures there are many local considerations as well as the size of the turbine which must be factored. Table II shows AIEE-ASME pressures and temperatures which should in general be satisfactory for various size turbines for steel mill application.

TABLE I

APPROXIMATE COST OF GENERATING PLANTS AS A FUNCTION OF STEAM PRESSURE AND TEMPERATURE

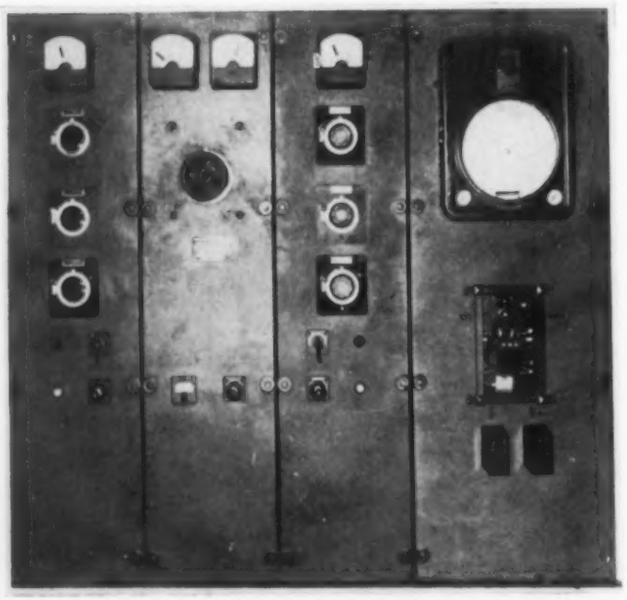
Steam pressure and temperature	Approximate per cent cost
400- 450 Psi—750 F	100
600 Psi—825 F	110
850 Psi—900 F	118
1250 Psi—950 F	125

TABLE II

SUGGESTED STEAM PRESSURE AND TEMPERATURE AS A FUNCTION OF TURBINE SIZE FOR STEEL MILL SERVICE

Turbine generator rating kilowatts	Steam pressure and temperature at turbine
11,500—15,000	600 psi—825 F
20,000—30,000	850 psi—900 F
40,000—60,000	850 psi—900 F
.....	1250 psi—950 F

Figure 6 — Load control panel installation.



THE GAS TURBINE

You have all heard much of the gas turbine. There have been several flow type units built and applied in certain industrial processes. These are merely pressure reducing valves in which the energy stored in the gas is extracted by a turbine which drives a generator or compressor. There have been a few experimental combustion type gas turbines built, however, there are no combustion type gas turbines in production in the U. S. today for industrial use. This condition will not last long, however, as manufacturers are rapidly developing practical combustion type gas turbines for land and transportation use.

The most natural application of the gas turbine would be in an area where there is an abundance of fuel available that is best suited for use in the gas turbine. This at the present time is either gas or oil, so we naturally look for the first applications outside of the transportation field to be in areas where there is an abundance of natural gas or where fuel oil has a favorable price compared with coal.

It might be asked why the steel mill is not a natural

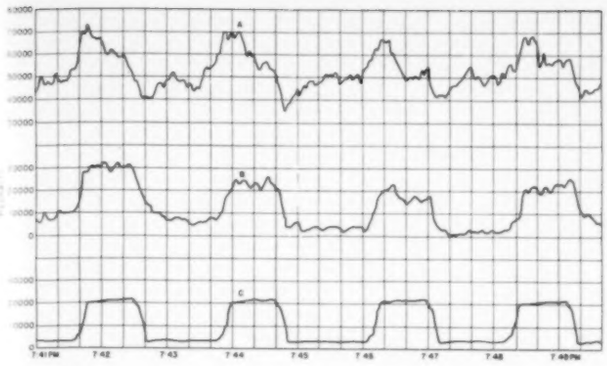
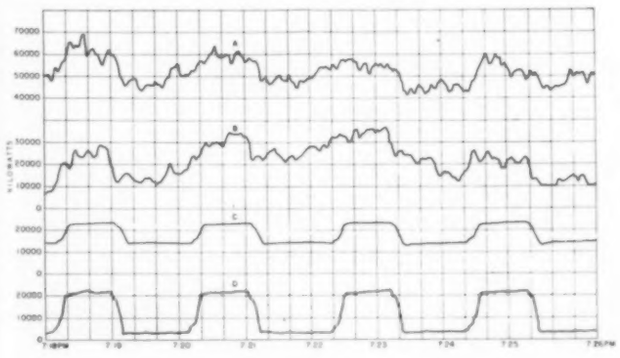


Figure 7 — The chart shows in curve A the kilowatt loading on Gorgas-Wilson dam 154 kv tie line. Curve B gives the kilowatt supply to T.C.I. and R.R. Co. by the Alabama Power Co. at Fairfield 110/44/6.6 kv step-down substation. Curve C gives the kilowatt loading on the hot strip mill.

application for the gas turbine because of the large amount of blast furnace gas available which could conceivably be used directly in the gas turbine. There are several considerations here. The first is that the blast furnace gas is not clean. While the larger dust particles can be removed by mechanical cleaners there will still be considerable dust in it which might be abrasive to the turbine buckets. It may be that electrostatic precipitation would clean the gas so that it could be used successfully in a gas turbine. Secondly, steam requirements might indicate that even though gas turbines were available, a certain percentage of the generating capacity would be steam driven. Application of heat exchanger to recover the heat in the exhaust of the gas turbine may permit production of some low temperature low presure steam. A third factor and perhaps the most important consideration is the very low heat content of blast furnace gas. This presents problems of providing enormous quantities of this gas at the proper pressure and of burning it in the turbines. The adaptation of oxygen to blast furnace operation to enrich the air may aid in the solution of this problem.

Figure 8 — The figure shows the effect of load control on load curves. Curve A gives kilowatt loading on Gorgas-Wilson Dam 154 kv tie line. Curve B gives the kilowatt supply to T.C.I. and R.R. Co. by Alabama Power Co. at Fairfield 110/44/6.6 kv step-down substation. Curve C gives kilowatt loading on T.C.I. and R.R. Co. regulating generator. Curve D gives kilowatt loading on hot strip mill.



It is not intended to discourage you in thinking of the use of gas turbines particularly for driving blast furnace blowers. However, it is necessary to be realistic and point out that it is not likely that there will be gas turbines available to burn blast furnace gas within the next couple of years. The steel mill industry would be well advised to watch the progress in development of gas turbines in other fields for the next few years. It may prove that the gas turbine will be another tool for further increasing the efficiency of the steel making industry and of reducing its cost.

FREQUENCY

One of the fundamental characteristics of most steel mill systems is the wide use of 25 cycles. The real reasons for the wide adoption of 25 cycles was the desire to use low speed, direct connected motors for driving mills. In other areas 25 cycles was adopted because electrical designers did not in the early days of electric power know how to make a good 60 cycle rotary converter. Good gears were subsequently developed which permitted adopting the higher speed 60 cycle motors instead of 25 cycle motors in steel mills. As is well known the advantages of 60 cycles are:

1. Ready availability of 60 cycle power from the utilities.
2. More ready availability of 60 cycle utilization equipment. This includes the entire line of equipment from fluorescent lamps on up.
3. Lower total system cost.
4. Greater choice of motor speeds.

While the first two reasons may not be readily interpreted in terms of dollars and cents, there is nevertheless a real economic factor there in favor of 60 cycles. When it comes to the cost of the system within a steel mill there is a substantial saving at 60 cycles as can be seen by referring to Figure 1. As a matter of rule of thumb, 25 cycle turbo-generator sets are of the order of magnitude of $6 per kw more than comparable 60 cycle sets. Transformers run from around $1.50 to over $4 per kva more at 25 cycles than at 60 cycles. Motors run from approximately the same price in certain frame sizes and speeds up to as much as $12 per horsepower more at 25 cycles than at 60 cycles. There are other things that will increase the cost of the system such as increased cost of small step-down transformers, control equipment, etc. However, to arrive at some idea as to what this means in the overall cost of a practical system to use 25 cycles instead of 60 cycles, only 3 major items are considered in Figure 1, turbine generators, transformers, and motors. The figures for transformers and turbo-generators have been put on a per connected motor horsepower basis which for this example is 100,000 hp of connected motors and 25,000 kw of generating capacity. Assuming 1 kw per horsepower the turbine generator increased cost of $6.00 kw is equivalent to only $1.50 per hp of connected motors. The total in this example, which may be considered representative, is an $8 per horsepower premium for a 25 cycle system. Every time a 25 cycle system is expanded $8 per horsepower is spent for no benefit whatsoever.

The foregoing discussion indicates that most steel mill engineers are aware of and that it is not desirable to build any new mills at 25 cycles and that it is not desirable to expand old mills at 25 cycles. One might infer from this that if he has an existing 25 cycle mill that the power system should be changed over immediately to 60 cycles. That cannot be justified because the money has already been invested and it would require additional investment to take out the 25 cycle equipment and install 60 cycle equipment in its place. That type of procedure in general is not good economics or good engineering.

The adoption of 60 cycles permits a far greater selection of motor speeds hence often more economical and more satisfactory design of mechanical equipment. The available motor speeds, 300 rpm and above, are shown for both 25 and 60 cycles in Table III. There are 11

TABLE III

MOTOR SPEEDS

25 Cycle		60 Cycle	
		3600	
5	1500	1800	11
		1200	
		900	
	750	720	
		600	
	500	514	
		450	
		400	
	375	360	
		327	
	300	300	

excluding 3600 rpm for the 60 cycle motors and 5 for the 25 cycle motors.

SYSTEM PLANNING

One of the most important considerations in any modernization or expansion program is the preliminary planning. In every case, a system study should be made and a one-line diagram drawn of the kind of system most suited to the particular plant. This should be made without regard to any installed facilities. This shows the ideal and what one should work toward. Of course, such plans have to be tempered in view of existing conditions. However, the master plan and not what is installed at the present time should serve as a guide to the modernization and expansion program. On this basis, it can be concluded from the foregoing that any major expansion in existing 25 cycle mills should be made at 60 cycles. That this is sound has been pointed out by a number of cases recently where mill expansions have been made at 60 cycles in 25 cycle areas.

The adoption of 60 cycles in 25 cycle areas brings up many problems, one of which is how to go about making the changeover. First of all, the changeover should be adopted only when a new large mill or new power facilities of a major magnitude are being installed. These generally go together, that is where new mills are being added, new power facilities are also required. These can be put in at 60 cycles as shown in Figure 2 and either supplied from the utility system through a separate 60 cycle system or supplied from new 60 cycle generators in the steel mill company's power system.

Sometimes it is desirable to start the changeover by the installation of smaller loads such as a new blast furnace at 60 cycles. This load is unlike a mill load and is not of sufficient magnitude to require new power supply facilities. However, if it is known that modernization on a large scale is to take place and that 60 cycles will be adopted at least in certain areas of the mill, then these small loads like a new blast furnace can be handled best by a frequency changer for obtaining power from the 25 cycle system, Figure 3. A simple synchronous-synchronous frequency changer equipment is all that is required.

When the large mill loads are taken on at 60 cycles it immediately becomes desirable to employ a sizeable frequency changer between the 25 and 60 cycle systems, Figure 2. If 60 cycle power is purchased, then the frequency changer will enable maximum utilization of the 25 cycle generating equipment to supply power to the 60 cycle utilization equipment to reduce the demand, on the utility system. If both frequencies are supplied by company-owned generators, then the fre-

Figure 9 — This figure should be compared with the load center system given in Figure 10. In this system power is carried at the utilization voltage for the entire route.

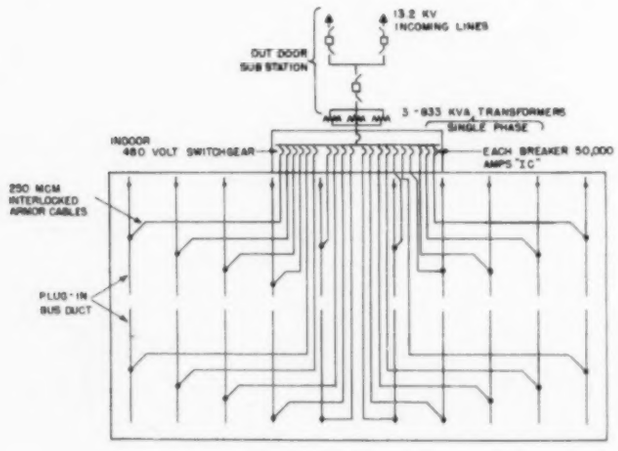
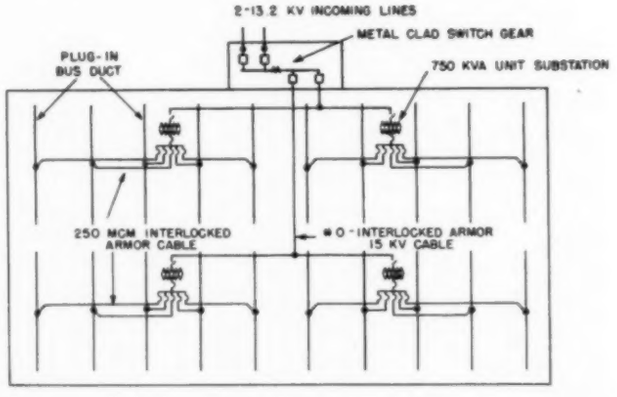

13.2 KV INCOMING LINES
OUT DOOR SUB STATION
3 - 833 KVA TRANSFORMERS SINGLE PHASE
INDOOR 480 VOLT SWITCHGEAR
EACH BREAKER 50,000 AMPS "IC"
250 MCM INTERLOCKED ARMOR CABLES
PLUG-IN BUS DUCT

Figure 10 — With the load center type of installation a saving of about 17 per cent is effected compared with the system shown in Figure 9.


2-13.2 KV INCOMING LINES
METAL CLAD SWITCH GEAR
PLUG-IN BUS DUCT
750 KVA UNIT SUBSTATION
250 MCM INTERLOCKED ARMOR CABLE
#0 - INTERLOCKED ARMOR 15 KV CABLE

quency changer ties between the two systems will reduce the turbine generator reserve required to a minimum as the reserve does not need to be duplicated in both the 25 and 60 cycle systems. As a rule of thumb, the size of the frequency changers in such instances should be in the order of magnitude of the kva ratings of the largest turbine generators in the 25 cycle system. This will allow for ample interchange of power between the two systems.

There need be no fear of wasting the investment in such a frequency changer set as the changeover from a 25 to 60 cycle system for an entire mill will generally take decades. Even though all 25 cycle generation may be obsolete and eventually retired, the frequency changer will still be useful for supplying loads driven by existing 25 cycle motors such as pump houses, fans, etc. The cost of changing such facilities from 25 to 60 cycles is more than just changing the motors. Often the difference in speeds obtainable will be such that complete new mechanical equipment is required as well as new motors. Because of this, it is expected that in any frequency changeover program 25 cycles will be in use for a good number of years.

A second important point in system design for changing frequencies is to recognize the fact that two more or less complete power systems, a new one for 60 cycles and the existing one for 25 cycles will be required for a good number of years. The first function of the 60 cycle system will be to pick up large spot mill loads. The function of the 25 cycle system will be to carry the remaining existing 25 cycle load, some of which will be in the same areas as the 60 cycle load. This leads us to the conclusion that we cannot look forward to much salvage value of the 25 cycle system for use on 60 cycles That refers particularly to transmission lines, switching stations, etc.

TYPE AND SIZE OF FREQUENCY CHANGER

We previously mentioned the adoption of frequency changers for ties between the 25 and 60 cycle systems. The question naturally arises as to which type of frequency changer is best adapted to this service. The major characteristics of the 3 most commonly used frequency changer is shown in Table IV. It is quite likely that a synchronous-synchronous set will not be adaptable because of inability to allow slight variations

TABLE IV

IMPORTANT CHARACTERISTICS OF THREE TYPES OF FREQUENCY CHANGERS

	Synchronous-synchronous	Scherbius	Electronic
Control power flow	..	X	X
Control reactive flow	X	X	..
Supply Rkva	X	X	..
Stub-end operations	X	X	..
Variable frequency ratio	..	X	X

in average frequency ratio between the two systems. If the synchronous set is large enough, of course, it could keep the two systems in step. To do this the kva rating of synchronous-synchronous set should in general be at least 20 per cent of the kva rating of the total generating capacity on the smaller of the two systems. For example, in Figure 4, if the 60 cycle system had 500,000 kva of generating capacity, including utility ties; and the 25 cycle system had a total of 40,000 kva generating capacity, then to keep the 40,000 kva, 25 cycle system in step with the 60 cycle systems, the frequency changer should in general be at least 8000 kva rating. Where it is not desirable to employ a synchronous frequency changer set which is large enough to hold the two systems rigidly together, then either the scherbius or electronic type can be employed. The characteristics of these have been outlined in previous papers given before the Association of Iron and Steel Engineers.

LOAD CONTROL

As shown in Figure 5 certain types of rolling mills cause large fluctuations in load. These fluctuations may be many thousands of kw's depending upon the size of the mill and may cause operating difficulties on the

Figure 11 — For very heavy power loads, the load center principle will effect major economies.

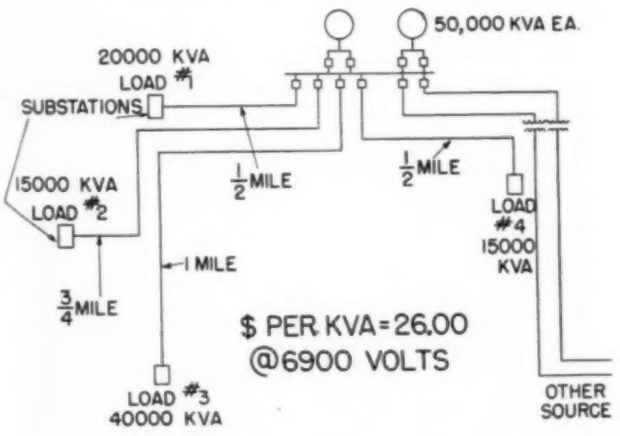
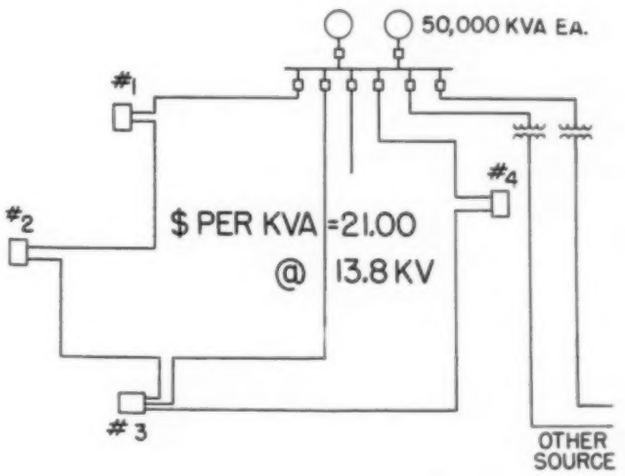


Figure 12 — A load center system similar to that shown in Figure 11 is shown except that 13.8 kv transmission is used with a saving of $5.00 per kva.



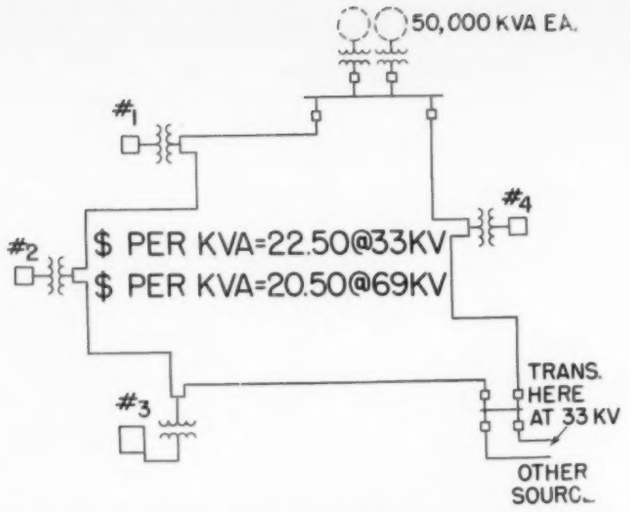


Figure 13 — The load center distribution system is the same as that shown in Figure 11. The cost per kva for 33 kv is however, $22.50 and that for 69 kv is $20.50.

utility system which supplies the steel mill. But what is often of more concern to the mill owner is that the billing for purchased electric power is often based on the maximum kva demand over a 15 minute or somewhat similar length of time. Hence, it is desired to take the power swings on the plant generating system as much as practical.

A type of control, shown in Figure 6, has been developed and used which can be connected in with the steel mill turbine generator governors to cause a large portion of these rapid load swings to be assumed by the steel mill generators and thereby even out the load curve on the utility. Typical load curves before and after installation of such control are shown respectively in Figures 7 and 8. This type of control reduces kva demand on the utility, hence may reduce power billing.

There are papers available describing the detail functions of this equipment.

The voltage surges caused by the fluctuating loads in many cases has been reduced to a satisfactory level by the use of automatic excitation control on the larger synchronous motors. This control causes the excitation to vary with load, hence causes these motors to draw substantially constant rkva while running. The kw demand varies with load on the mill. The kw component does not produce much voltage drop in the power system hence, there is less voltage variation due varying load on the large motors than if such control were not used. The rkva which does cause most of the voltage drop remains substantially constant, hence causing a voltage drop which is fairly constant and hence does not vary widely as the load on the large motor varies. This type of control is not adaptable to holding plant rkva constant because the plant load and that on a particular motor or set of motors may not vary together, hence the excitation on a given motor may be reduced when it should, so far as load requirements are concerned, be increased. This may cause this motor to pull out of step. Papers are available describing this type of control.

Another application of load control schemes is in conjunction with frequency changer ties between 60 cycle utility systems and 25 cycle steel mill systems. In this case, the load control can be used to limit the demand on the power company and thereby limit the demand charges and obtain maximum amount of power from the utility for minimum cost.

This type of equipment is relatively inexpensive and may offer large savings in power bills particularly where the cost of power is based primarily upon peak demands rather than on an energy basis.

DISTRIBUTION SYSTEM VOLTAGE

When one is planning a new mill or planning a conversion of an existing mill from 25 to 60 cycles there are certain factors which are of basic importance in designing the new distribution system. At the top of this list is selection of voltage and 6900 volts has been a common steel mill voltage. There are enormous systems operating at this voltage level. A study of these systems in light of present day practices indicates that for small and medium size steel mills the generation and transmission voltage of 13.8 kv is less expensive than 6900 volts. The larger motors will be operated directly from 13.8 kv. While these motors will cost around $1.50 more per horsepower at 13.8 kv than at 6.9 kv, this extra cost is more than saved by the fact that a 13.8 kv power system will cost about $3 to $4 less per kva than a 6900 volt system. For example, only one-half as much copper is required to transmit a given kva of power of 13.8 kv as at 6.9 kv, and switchgear-wise 1200 ampere breakers will carry more kva load at 13.8 kv than the more expensive 2000 ampere breakers will carry at 6.9 kv.

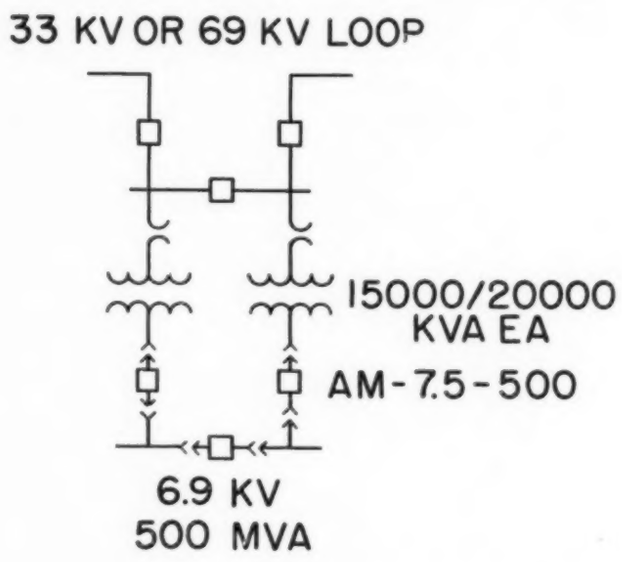


Figure 14 — 30,000 kva substation layout.

Whether the generation and transmission voltage be 13.8 kv or 6.9 kv, there should be a medium utilization voltage to take care of motors in the range of about 200 to 2000 horsepower where 460 volts is too low and 6.9 kv or 13.8 kv are too high for some of these motors.

See Table V. A voltage of 2400 generally best fits this

TABLE V

SMALL AND MEDIUM SIZE MILLS

Generator, transmitter and large motor voltage	Medium size motor utilization voltage	Small size motor utilization voltage
13.8 kv	2.4 kv	460 volts

LARGE MILLS

*Generator and transmitter voltage	Large size motor utilization voltage	Medium size motor utilization voltage	Small size motor utilization voltage
33 kv or 69 kv	6.9 kv	2.4 kv	460 volts

*Generated voltage stepped up through transformers to their voltages

picture. This may seem to be somewhat at variance with the publicity that has been given 4160 volts in preference to 2400 volts in general industrial application. In these cases, 2400 volts is referred to as a distribution voltage and not as a utilization voltage. In the case of steel mills, 2400 volts is referred to purely as a utilization voltage and not for the transmission of power any distance. In all cases, there will of necessity be 460 volts for small utilization devices.

DISTRIBUTION SYSTEM LAYOUT

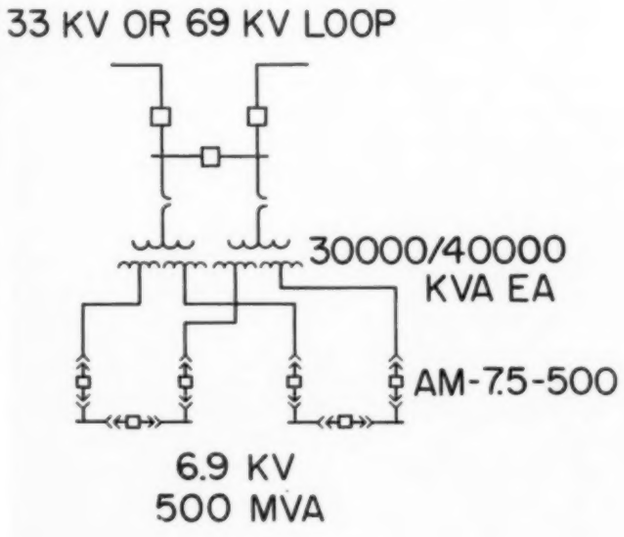
Large steel mills were among the first to use what is now called the load center system, Figure 10. This system is now used very extensively for distribution of power to low voltage utilization devices in industrial plants. The principle and economics of the load center system are shown in Figures 9 and 10. In the old style system, power is carried all the way at utilization voltage and in the load center way (Figure 10), power is carried most of the way at high voltage to small substations. The saving via the load center method is about 17 per cent.

The same fundamental principle can be adopted at higher voltage in large steel mill systems and similar savings made. A typical example would be a large steel mill having a demand of around 100,000 kva as shown in Figure 11. This is far too much power to even consider 6900 volts in a new or expanded system and not only for reasons of first cost. Considerable more space would be required for switchgear and transmission circuits. A comparison has been made on such a system using the load center principle with 13.8 kv, 33 kv and 69 kv. These are shown in Figures 12 and 13. The cost figures shown include power house switchgear and transformers, transmission line, substation transformers and switchgear, but do not include feeder breakers at substations. It will be noted that the 69 kv system is the least expensive. However, the 13.8 and 33 kv systems have the distinct advantage that metal enclosed switchgear is available and was assumed to be used in these comparisons for these voltages. This, together with cable (aerial or underground) permits a completely metal enclosed power system essentially free from the insulator cleaning problems associated with open lines and switchgear, hence, will reduce maintenance costs.

Either the 69 or 33 kv systems used the load center principles whereby power is transmitted at 33 kv or 69 kv to load center substations and there stepped down to utilization voltage. In this case the utilization voltage would be 6900 volts because it is used only at spot areas and to allow for lower cost large motors. Again, it would be desirable to have utilization voltages at 2400 and 460 volts.

Step-down substations for such a system can consist of two transformers rated approximately 15,000 kva and yet not exceed 500,000 kva interrupting duty on the low voltage side, see Figure 14. This permits the application of standard removable breaker metal clad switchgear. Where larger spot loads are encountered, substations consisting of two 30,000 kva units with split secondaries as shown in Figure 15 can be used.

Figure 15 — 60,000 kva substation layout.



CONCLUSIONS

1. In summarizing, it is the viewpoint of the author that because of the increasing plant investment required by power generation in marginal cases where there is consideration between purchased power and generated power that the trend will be more toward purchased power.

2. While there have been rapid strides made in increasing steam pressure and temperatures for utility turbines, it is not expected that the highest steam pressures and temperatures can be proven economical in steel mills where low cost blast furnace gas is used for fuel and where loads are such that the more expensive high pressure units could not be fully loaded 24 hours a day.

3. While rapid strides are being made in the development of the gas turbine, it is not expected that a gas

turbine suitable for burning blast furnace gas will be available immediately.

4. There is a major trend toward the use of 60 cycle a-c instead of 25 cycle a-c for major expansions and steel mills.

5. The adaptation of 60 cycles in 25 cycle areas will generally require the adoption of frequency changers to tie the systems together.

6. It will not be economically feasible or good judgment to completely discard a 25 cycle installation and replace it with a 60 cycle installation. The changeover will come gradually with only new large loads being placed on the 60 cycle system at first.

7. Load control means are available for reducing the peaks on utility systems caused by steel mill loads.

8. The planning of distribution systems is a most important item. One of the major factors is that of selection of proper voltage and system arrangement. Higher voltages than 6900 volts are desirable. For very large steel mill systems, the load center system using 33 or 69 kv as transmission voltage will be found most desirable.

DISCUSSION

PRESENTED BY

D. L. BEEMAN, Engineer, Industrial Power Division, General Electric Co., Schenectady, N. Y.

F. MOHLER, President, Patterson-Emerson-Comstock, Inc., Pittsburgh, Pa.

R. S. HURTT, Assistant Electrical Superintendent, Crucible Steel Co. of America, Midland, Pa.

J. J. BOOTH, Division Superintendent of Maintenance, Carnegie-Illinois Steel Corp., Duquesne, Pa.

Member: Mr. Beeman has been quite explicit in regard to these 25 and 60 cycles, but did not mention a word regarding the 50 cycles. I am interested in one plant where everything is going to be on 50 cycles. Would you give comment on 50 and 60 cycle systems?

D. L. Beeman: Because we have very little 50 cycle power in this country, we have not spent any time studying that frequency compared with 60 cycles. We have, however, run across many foreign systems. In South America and other parts of the world, 50 cycles have been used instead of 60 or 25 cycles.

I do not think 50 cycles is going to increase the cost over 60 cycles as much as 25 cycles will. First of all, there are many pieces of equipment which are common for both 50 and 60 cycles, for example, the same motors may in some cases be used on 50 and 60 cycles; of course the speeds are different. Transformers are not too different at 50 and 60 cycles, therefore the cost of transformers may not be a significant factor. However, taking an entire system, I do think if you buy equipment in the American market you will find there will be a slight increase in cost for the 50 cycle system in comparison to the 60 cycles, just because it is off standard. Turbogenerators are slightly more expensive at 50 cycles than 60.

In a country where everything is 50 cycles, 60 cycles in that country might present some of the same problems that 25 cycles present in this country. The answer cannot really be determined except by actual analysis of the situation as you find it.

F. Mohler: Mr. Beeman has covered a lot of territory in a very short time and given us many "rules of thumb" and short cuts for quickly appraising, at least in general, many of our distribution problems.

I cannot emphasize too strongly that we be very careful before we expand any of our 25 cycle systems. I have entirely too many cases of "throwing good money after bad." I have heard so many times "this is the last expansion we will ever have here and we might as well continue with our 25 cycles." The instances where that "last expansion" has been only the beginning are too numerous to mention.

Furthermore, obsolescence and modernization of eqipment is continually taking place whereby a-c drives are being replaced with d-c drives and m-g sets. Twenty cycle m-g sets and other equipment for these programs will cost you many an extra dollar and you can usually say "there is one I will have to write off the books one of these days."

May I, therefore, strongly recommend you take a good cold look before you decide.

R. S. Hurtt: We too have a 25-60 cycle frequency problem. Our new equipment is going in at 60 cycles but we are still adding to the old 25 cycle and getting up to capacity on 25. What we are going to do I do not know, we are going to have to put in all new equipment at 60 cycle or run out of power, and also out of power from the utility.

J. J. Booth: Some of us here in the Pittsburgh district have gone through disturbing power problems in the advancement of industry for more years than we might care to mention. You raised the question of the 25 cycle and why it was adopted, and you are partially correct when you say it was on a question of low speed. We also bring into that picture that at that particular time there was the difficulty of getting a suitable material to go into gears to give us the proper gear reductions. so, therefore, we adopted the 25 cycle on this account as well as this lower speed.

I do not think you missed very many things in your paper. You have covered an extensive field excellently and we have enjoyed it very much. We have, right here in the Pittsburgh district, the generating problems, the transmission problems, the conversion problems, and the distribution problems. I do not think you have listed a one but what we have had experience with in this district.

The gas turbine is one thing that you did not dwell on at any very great length. I would appreciate your going into that more fully in just a few minutes as I too believe the gas turbine will be extensively used in the not too distant future on many present day applications where we are now using steam, diesel, etc.

D. L. Beeman: I would like to be able to tell you more about gas turbines but I think that a year or a year and a half from now, that it is going to be possible to talk much more intelligently about the gas turbine than I can today.

HEATING AND TREATMENT OF ALLOY STEELS

. . . . the new tool steel annealing furnaces described use, on the average, a mixture of 6000 cu ft of nitrogen and 315 cu ft of propane . . . . the fuel rate is 300 lb of bituminous coal per ton of steel . . . . no decarburization occurs, and carburization does not exceed 0.005 in. on a side . . . .

By A. H. ARBOGAST, Engineer of Combustion
and
M. K. MORRIS, Engineer of Combustion
Bethlehem Steel Co.
Bethlehem, Pa.

▲ THE recent modernization of the production facilities in the tool steel department at the Bethlehem plant of Bethlehem Steel Co. included the installation of five bell-type, gas fired furnaces, to meet the capacity and quality requirements in the heat treatment of high-speed and air-hardening grades of tool steels.

These furnaces were designed for direct firing with desulphurized coke-oven gas, with the combustion system equipped with a two-zone temperature program control. Both the outer covers and the inner covers, or bells, are interchangeable and may be used with any of the five furnace bases.

The function of the inner cover is to protect the charge from scaling and decarburization. This is accomplished by circulating a controlled atmosphere—a mixture of nitrogen and propane, under the inner cover during the annealing cycle. This inner cover, which is made of heat-resistant alloy, is equipped with an oil seal to prevent infiltration of outside air or the products of combustion into the treatment atmosphere. The adoption of a controlled atmosphere of nitrogen and propane in this system was based on previous research with these gases in treatment furnaces.

The design of the furnaces included all practical and applicable features assuring gas tightness. In the following are presented some of the more important features in their construction.

The box-type bases (Figure 2), are of welded steel construction, bricklined, with all pipes and thermocouple connections welded in place to prevent leakage. The hearth is surrounded by a steel trough which is a welded integral part of the base. This trough is filled with oil and serves as an airtight seal for the inner cover. Water circulating through a system of pipes in the trough maintains the correct temperature of the oil seal.

Distributing pipes for the nitrogen-propane atmosphere and protection tubes for the two thermocouples are admitted at both ends of the base.

The cradles, (Figure 3), that hold the charge of bars during annealing are fabricated from alloy steel with 25 per cent chromium and 12 per cent nickel. They are supported on base plates of all-welded construction, equipped with four cradle posts to insure proper alignment of the cradle when the inner cover is placed on the base.

The inner covers (Figure 4), made of the same alloy steel as the cradles, are of all-welded construction with corrugated side walls and a horizontal bottom skirt that fits flat on the base and is provided with a vertical extension on the outer edge which dips into the oil seal. This assembly is strengthened against the stresses of expansion and contraction by the insertion of a series

Presented before AISE Philadelphia District Section Meeting, December 8, 1947

Figure 1 — These annealing furnaces were recently installed in the tool steel department of the Bethlehem Steel Co., Bethlehem, Pa.

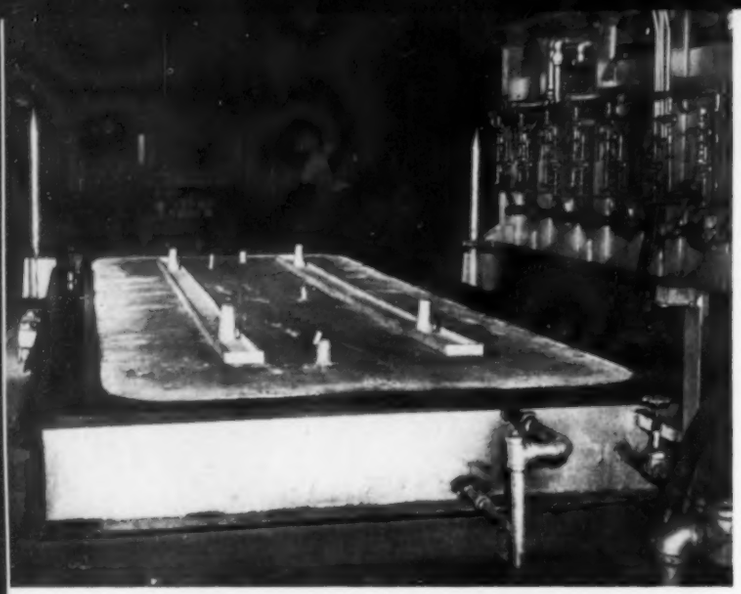


Figure 2 — The base plates were fabricated by welding. Photograph also shows the oil seal trough, thermocouples and atmosphere piping.

of angular expansion blisters where the side and end walls join the bottom skirt.

The outer covers are refractory-lined steel boxes or bells on which the burners and the flue gas eductors are mounted. There are twenty low-pressure luminous-type burners to each bell, ten on each side, arranged in two zones of ten burners each, five to a side, with the combustion in each zone under separate control. They are designed to burn the major part of the gas at the bottom of the combustion chamber. Auxiliary gas may also be injected into the upper zone of the combustion area to provide added luminosity, if required.

Fuel gas is supplied to the burners at 6½ in. water pressure by means of a flexible hose equipped with a quick-acting coupling, and combustion air at the rate of 1000 cfm, at 20 in. water pressure, supplied by a blower mounted at one end of the bell.

The air-fuel mixture for each zone is proportioned by a valve on top of the bell. This air fuel ratio is checked with the aid of well-type manometers mounted on the bell, which indicate the air and gas presure in the respective headers after the proportioning valves.

The heat input into the furnace is entirely controlled by the throttling action of the proportioning valves. The proper response of these valves is maintained after the initial setting by the action of the recording temperature controllers connected with the proportioning-valve motors.

Combustion (Figure 5) takes place in U-shaped baffles, constructed of corrugated tiles and set in the side walls of the bell. They cover the burners and are provided with a full opening at the top, and slots at the bottom to permit the escape of burning gases into the bottom zone of the inner bell, thus insuring uniform heat distribution.

The flue gases are removed from the furnace by the two previously mentioned eductors which are installed at opposite ends of the outer cover and are activated by air from the blower which furnishes air for the combustion. This arrangement provides excellent circulation in the furnace.

Four ports are installed in the outer cover, two in each end wall, to permit visual inspection of the burner operation and inner cover temperature conditions.

Like the inner bell, the outer cover is equipped with a vertical downward extension or knife edge which dips into the oil trough, thus completing the gas seal.

Two thermocouples are located in the roof and are suspended over each end of the inner cover. A separate two-point temperature recorder-controller is provided at either end of the furnace, with each recorder-controller connected to a roof and base thermocouple. The roof couple which is exposed to furnace atmosphere, controls the temperature until the base couple reaches a predetermined point, at which time the base couple takes over. A check box for testing the couples is mounted on the panel.

Program controllers regulate the heating cycles, one controller for the soaking period (0-40 hrs), and one for the cooling period (0-100 F per hr).

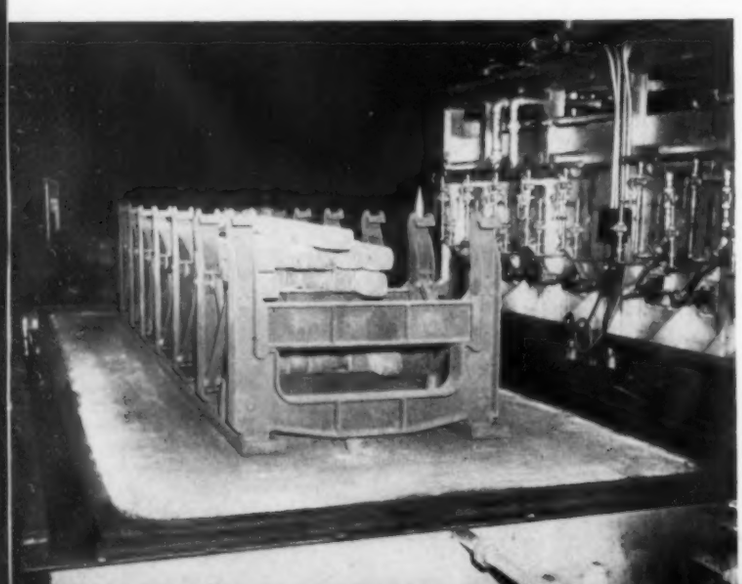
Briefly, the consumption of coke oven gas during the combustion cycle ranges from 100 to 5,200 cfhr, with the resultant flue gas containing 10 per cent CO_2, 0.2 per cent O_2, and 0.0 per cent CO, and with a furnace pressure at high heat input of plus 0.18 in. water and minus 0.02 in. water at minimum flows.

The metallurgical atmosphere, as previously noted, consists of commercial nitrogen (oil-pump grade) piped into the plant, containing 0.5 to 3.0 per cent oxygen, dried to a dew point of minus 65 F and mixed with 3-8 per cent propane.

Nitrogen at 15 psi is supplied at the point of consumption where the pressure is reduced to 5 psi. Propane is supplied at 20 psi from 6250 gal storage tank located in the plant and is also reduced to 5 psi before delivery to the panel. Both gases are proportioned by recording and indicating rotometers. The ratios are maintained by an air-loaded throttling valve in the nitrogen line which in turn responds in ratio to the manual propane setting.

Flow of the atmospheric gas is reversed from one end of the charge to the other by use of an automatic program timer located on the panel board for each base.

Figure 3 — A loaded charging cradle is shown in place, and the base is ready for the inner cover.



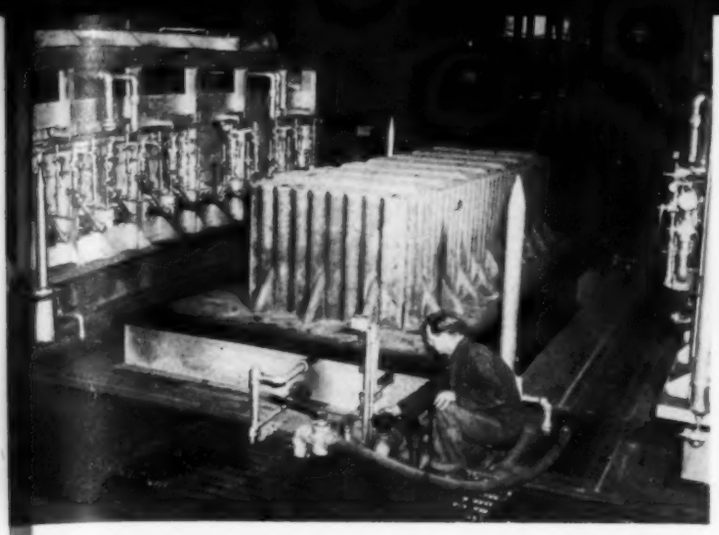


Figure 4 — The inner cover is shown in place on the base.

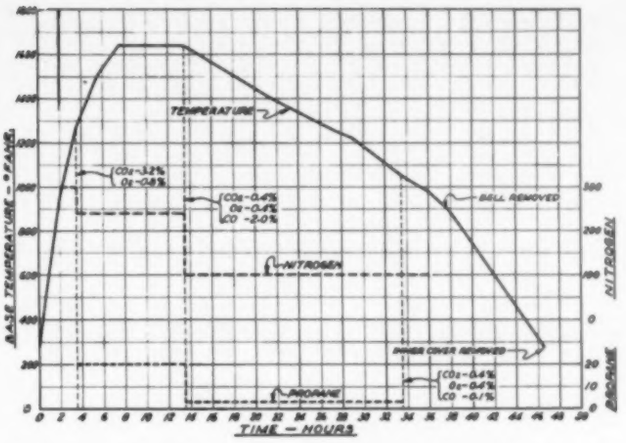


Figure 6 — This diagram gives the nitrogen and propane flows and the base temperature curves.

and pressures are recorded as an index to atmospheric density and circulation through the inner cover.

The atmospheric gas is analyzed manually. A specifically developed CO_2 recorder with a range of 0-5 per cent CO_2 was first installed, and it gave good service. However, the use of this instrument was discontinued after experience proved that, due to the many variables, including variable oxygen in the supplied nitrogen and oxides present in the furnace or in the charge, the CO-CO_2 ratio cannot be properly maintained and followed by CO_2 determinations alone.

A typical cycle for a charge of 10,000 pounds of high-speed steel from bell on to bell off is 44 hours, of which 12 hours are required for heating, 6 hours for soaking and 26 hours for cooling. Cooling is controlled to give a temperature drop of 30 F per hour down to 900 F, as registered by the base couples.

During the heating cycle (Figure 6), when the base couples reach 950 F, the inner cover is purged with 300 cu ft of nitrogen per hour until the oxygen content has dropped below 3 per cent. The flow is then reduced to 240 cfhr and propane is introduced at the rate of 20 cfhr. The flow-reversal cycle is set for 15-minute periods.

After the introduction of propane, the reduction cycle requires a more careful control of the CO_2-CO ratio until a maximum of 1 part of CO_2 and 3 parts of CO has been reached. At this point the flow of nitrogen is cut to 100 cfhr and the propane to 3 cfhr, the inner cover pressure is raised to 1 in. water. An effort is made to maintain a ratio of 1:3 for the balance of the heat.

When the cooling cycle has reached 1050 F, the propane is shut off and the inner cover is purged with nitrogen until the base couples have dropped to 980 F. At 900 F, the outer cover is removed and placed on another base for the start of a new heat, while the inner cover remains in place until the base couples drop below 300 F.

On an average heat, 6000 cu ft of nitrogen and 315 cu ft of propane are consumed. The metallurgical atmosphere has responded well to requirements. The residual oxygen carried by the nitrogen has never prevented the successful establishment of proper carbon balances by addition of propane.

A certain amount of tarry residues formed by the cracking of the propane in the furnace are deposited in the atmospheric exhaust lines. This necessitates periodic cleaning of the exhaust lines.

On the whole, the results obtained from this newly

Figure 5 — With the bell in the raised position, one thermocouple, one eductor pipe, and refractory baffles can be seen.

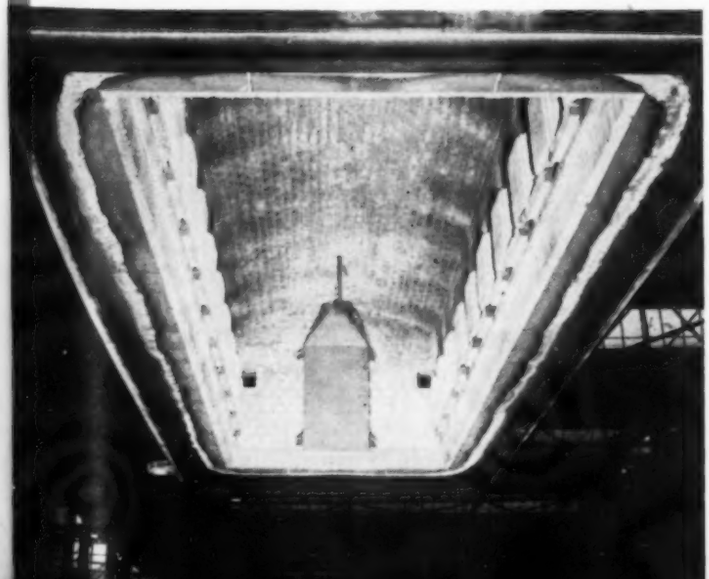
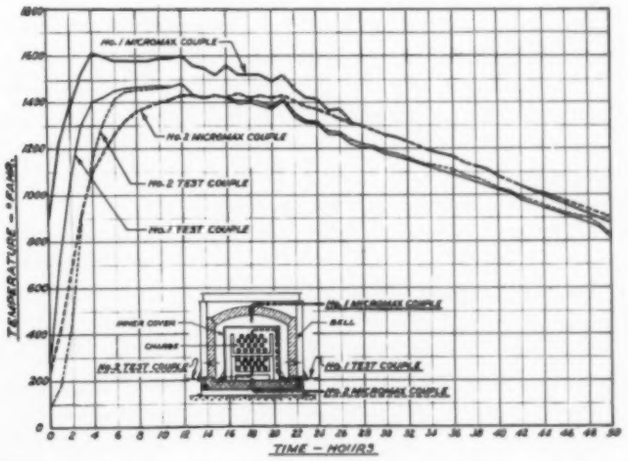


Figure 7 — Buried thermocouples were used for a test and the resultant temperature curves are given in this figure.



developed furnace system have been very gratifying. To date there have been no difficulties due to surface decarburization, although we have experienced some slight carburization. These effects, however, are the result of operating conditions and should be followed and corrected from heat to heat by proper manipulation of temperatures, pressures, and atmosphere flows.

DISCUSSION

PRESENTED BY

GEORGE ECKARDT, Assistant Superintendent, Treatment Department, Midvale Co., Philadelphia, Pa.

WILLIAM L. FORREST, Foreman, Bethlehem Steel Co., Bethlehem, Pa.

J. C. HARRIS, General Manager, Drever Co., Philadelphia, Pa.

E. K. SPRING, Chief Metallurgist, Henry Disston and Sons, Inc., Philadelphia, Pa.

A. J. FISHER, Assistant Chief Engineer Construction, Bethlehem Steel Co., Bethlehem, Pa.

JOHN S. MORRIS, Methods Engineer, Lukens Steel Co., Coatesville, Pa.

GEORGE J. CAMPBELL, Combustion Engineer, Bethlehem Steel Co., Sparrows Point, Md.

F. H. SPIESS, Fuel Engineer, Combustion Department, Alan Wood Steel Co., Conshohocken, Pa.

F. C. SCHOEN, Maintenance Engineer, Alan Wood Steel Co., Conshohocken, Pa.

L. G. COSCIA, Engineering Department, Bethlehem Steel Co., Sparrows Point, Md.

L. W. JOHNSON, Heating Specialist, General Electric Co., Philadelphia, Pa.

WILLIAM N. HORKO, Engineer, Henry Disston and Sons, Inc., Philadelphia, Pa.

N. C. BYE, Director of Engineering, Henry Disston and Sons, Inc., Philadelphia, Pa.

H. L. GIFFORD, Bethlehem Steel Company, Bethlehem, Pa.

A. H. ARBOGAST, Engineer of Combustion, Bethlehem Steel Co., Bethlehem, Pa.

George Eckardt: In your remarks about finding a slight carburization, do you have any process whereby you can "neutralize" that condition, such as repeating the annealing process and modifying your furnace gases? Also in your paper, you said you arrived at a six-hour soaking period. Was that arrived at through experience only, or do you have means of telling when the charge is heated uniformly, throughout?

William L. Forrest: The author's explanation was quite complete. However, I would like to elaborate on a few points at this time and also discuss phases of furnace atmospheres.

The inner covers are made of alloy steel with 25 per cent chromium and 12 per cent nickel. This alloy composition requires conditioning prior to use to establish standard ratios of CO_2 to CO. This conditioning treatment requires 100 to 160 hours, using nitrogen and propane gases to establish a thin carbon deposit on the cover. The base also requires conditioning, but of shorter duration, at temperatures between 1520 to 1650 F. This conditioning helps to establish CO_2:CO ratios and to maintain these ratios for temperatures below 1520 F.

The reducing atmosphere is attained by introducing propane gas into the furnace, diluted with nitrogen gas. Mixtures of 1 to 8 per cent propane have been found satisfactory.

Steels must first be segregated according to composition, then according to annealing temperature. It is possible to anneal different compositions of various carbon contents, using the same flows. For example, tungsten high-speed steel of 0.70 to 0.76 per cent carbon content and chromium-tungsten-molybdenum steel of 0.30 to 0.38 per cent carbon content can be annealed together at the same temperature, same flows and ratios, and still maintain their respective carbon contents. This is probably due to the fact that chromium and tungsten retard the absorption of carbon. If a molybdenum steel of 0.80 to 0.86 per cent carbon were annealed with the above grades, it would have decarburization to a depth of 0.010 to 0.015 inches, per side. However, if the above steels were annealed together with enough propane introduced to maintain 0.80 to 0.86 per cent carbon content, it would be found that 0.30 to 0.38 per cent carbon steels would be carburized to a depth of 0.015 to 0.020 inches per side. The 0.70 to 0.76 per cent carbon content would be carburized 0.005 to 0.010 inches per side.

The two above results are obtained when using CO_2:CO ratios of 1:3 and maintaining them as close as possible. When the annealing temperature drops below 1520 F, ratios of 1:5 CO_2:CO are necessary to maintain carbon contents of mild alloy steels with the carbon ranging from 0.40 to 0.73 per cent.

When using the same flows as those for the previous mentioned steels, decarburization would be encountered to such a depth that it would be necessary to scrap the material despite the fact that the carbon contents of these steels are lower than that of the high-speed steels. This we feel is due to the temperature, since less than 100 per cent cracking of the propane is encountered as stated in the book, "Reactions of Pure Hydrocarbons," by Egloff. Thus, in order to maintain the carbon content of mild alloy steels, it is necessary to set up higher initial flows, maintain them longer, and increase the dilution of the low flows in an effort to maintain a 1:5 ratio of CO_2 to CO.

When using a nitrogen and propane atmosphere with temperatures above 1500 F, it is necessary to reduce the flows as soon as possible in order to eliminate excessive sooting. This is not so important at lower temperatures, provided they are not run for excessive periods of time, as the cracking of propane is reduced below 1520 F.

In closing, let me state that this unit is not a carburizing unit, despite the fact that slight carburization is encountered. In order to protect the steel we must aim for an atmosphere on the carburizing side, since decarburization takes place much more readily than does

carburization. It is essential to the annealing unit that the mills and hammers supply material to it with minimum amounts of decarburization if the annealing is to be successful.

J. C. Harris: I take it that silica carbide refractory blocks are being used to prevent flame impingement on the cover. It would be interesting to see the same type of furnace designed with radiant burners in order to obtain a comparison. I do not know of any way to do it other than to take one of those furnaces and equip it with that type of burner, but I believe there would be good heat distribution without the necessity of depending on direction of gas flow and luminosity to give equal temperatures.

The atmosphere discussion covers a broad scope. The introduction of propane into nitrogen in varying amounts can cover a wide field of applications, but as has been stated, carbon deposits and tar occur when the propane cracks.

I think the gas equilibrium for carburization in the nitrogen-propane mixture is probably due primarily to the methane content of the cracked propane and there is a definite balance there between carbon content of the steel, the temperature and the ratio of the percentage of hydrogen to the percentage of methane. If a gas is in equilibrium with the carbon in one steel, and if there is present another steel of different carbon content, the gas is either going to be carburizing or decarburizing, if the carbon content is less or greater than the first specimen.

This coincides with what Mr. Forrest said in his discussion. Now, there is another thing concerning atmospheres that was not brought out. There was a fine article several years ago in which the fact was brought out that there is an oxidizing and reducing condition for iron and iron oxide for every temperature depending on the ratio of percentages of water vapor to hydrogen and also carbon monoxide to carbon dioxide—these two curves have opposite slopes. When you maintain a product in an atmosphere which is in perfect equilibrium for one temperature, and then cool that product in that same atmosphere you get different equilibrium conditions. I think for all of us interested in atmospheres, that this is an absorbing problem. You people at the Bethlehem plant who are heating tool steel in the nitrogen-propane mixture have answered many problems by reducing the CO and CO_2 down to low percentages.

E. K. Spring: When the company with which I am associated first undertook work on protective methods in handling steel, it was thought desirable to make the most of existing equipment. This called for a somewhat different line of attack than had we been installing new equipment designed for the job.

Without doubt the place to start work in considering atmospheres for annealing purposes is at the mill rather than the annealing furnaces. The best of atmosphere control during annealing is wasted if the steel products going to the annealing are not in good condition. Care at annealing cannot salvage poor material.

Control of combustion in forge or mill furnaces should be enforced as carefully as in any modern boiler plant, the purposes differing in the two operations, of course. There seems to be some balance between scaling and decarburizing atmospheres which will heat the greatest tonnage for rolling and have best practicable surface and decarburization conditions. In my own experience, I have observed, where control of combustion was instituted, an appreciable increase in production and tremendous improvement in freedom from decarburization was enjoyed.

During this work comparisons of various heating and loading cycles with atmosphere were made, and it was very evident that small charges heated quickly under controlled atmospheres gave better production and results than larger charges given long cycles with or without atmospheric control. These facts were an invaluable guide in building new furnaces with time, temperature and atmosphere control.

During work preliminary to installation of atmospheric protection equipment, various sealing agents were employed to contain the gas within the covers used over bars, plate and coil stock. The idea behind this was a desire to permit carrying higher gas pressures within the hoods to combat any "breathing action" during the annealing cycle.

During these experiments trouble was found with chrome ore carrying some small percentage of iron oxide, something over one per cent. Using a gas mixture containing free hydrogen, the ferric oxide in the chrome ore reduced to ferrous-oxide as a result of reaction with the hydrogen giving off water vapor and no better decarburizing agent is known. The ferrous iron present before exposure was 0.70 per cent; after exposure 1.17 per cent. The little water vapor evolved by this reduction appeared to have been sufficient to give trouble.

Thoroughly dried sand (SiO_2) gave a fairly good seal with fair results on the product. Alumina (Al_2O_3) was equally good. Both of these, however, were felt to be light and consideration has been given to other sealing agents looking at specific gravity and inertness.

Sand	—SiO_2	—Specific gravity = 1.7
Alumina . .	—Al_2O_3	—Specific gravity = 3.7
Zircon	—ZrO_2	—Specific gravity = 4.6
Chrome Ore.		—Specific gravity = 5.0
Zirconia . . .	—$ZrSiO_4$	—Specific gravity = 5.7

With the exception of the chrome ore, any of the above should be capable of giving good results.

In undertaking any work along these lines attention and care must be given to containers which should preferably be of the stainless type. When first put in use they should have been cleaned free of scale. The protective gas must be applied under some slight pressure. As little as less than 1 in. water may serve. Prior to delivery to the heating furnace, it should have been dried. My personal belief is that this is better than attempting to "soup up" the gas with carburizers, as propane.

A. J. Fisher: I would like to ask Mr. Morris three questions. The first one is just how does he take the sulphur out of the fuel gas, and why is it necessary to take out the sulphur? Our problem is a little different at Sparrows Point. We are using plain steel covers and we do not take out the sulphur.

The second question is: Our temperature control is "on-and-off" for tinplate and flat sheet products, and I assume that in the Bethlehem case the control is full-floating. Is that correct?

The third question is: What is the fuel rate and the charge weights of the various heats? I would like to have some idea as to what quantities you charge and what are the resultant fuel rates.

John S. Morris: On the inner cover I would like to know the gage of the plates used in its manufacture, and the approximate number of heats you get for the life of the cover?

G. J. Campbell: What is the end to end temperature, and the top to bottom temperature on the charge inside the inner cover? Have you experienced any difficulty with your alloy covers, and if so, what is the present analysis and what was the previous analysis before you had your trouble? I would also like to know why you use an oil seal in preference to a sand seal?

F. H. Spiess: I would like to know something about the top burner on the outer cover. As I understand it, you use this burner to obtain a luminous flame; but, I do not quite understand why you need luminosity at that location in a furnace of this type.

F. C. Schoen: How much does it raise the cost of annealing a product per pound or per ton over the old method, not using atmospheres? In other words, some of the steels that have little profit margin, to add another cent or cent and a half per pound annealing cost will price you out of the market. A second question, are your gas and your propane ratios determined experimentally for the various compositions of steel or have you some more or less fool-proof formula to start off with, requiring only checking for final results?

L. G. Coscia: I have a few questions. First, what is the size of the inner cover and do you have any details on the structural design? Secondly, do you have any mechanical method of recirculating the prepared atmospheres under the inner cover. Third, you mentioned that the prepared atmosphere was introduced at one end, and then at the other end. Why is that done and how did you determine the cycle?

L. W. Johnson: During this talk and discussion, the authors spoke of using the nitrogen enriched by propane. The same analysis of furnace atmosphere can generally be obtained cheaper by other means, I am thinking particularly of burning air with the natural gas, or propane, rather than using the piped nitrogen supply which is not available to most people. I think it should be brought out why the authors selected commercial nitrogen, rather than the conventional atmosphere converter.

William N. Horko: What is the life of the inner covers and what type of metal is used in the support for holding the charge?

N. C. Bye: I would like to know the pressure in the combustion chambers and under the cover. It seems as though there is a slight negative pressure in the combustion chamber and a positive pressure under the cover. I would also like to know if you consider the surface conditions of your charge, that is whether it is a pickled charge free from scale, or as rolled, in determining the type of atmosphere you would use in the atmosphere control cycle.

H. L. Gifford: In this operation Mr. Morris speaks particularly of high-speed steels. In the alloy and tool steel division at Bethlehem, we also anneal the regular engineering steels. There we use nitrogen and propane. We not only have gas-fired furnaces but also electrically heated furnaces, and we use an atmosphere in the furnace without hoods, as well as with hoods. There we have every analysis you can think of and most every temperature you can think of. But how do they arrive at the proper composition whereby 5 of CO to 1 of CO_2, or negligible CO_2? We know that certainly it requires much more CO, in fact we have known that for years, and so I wondered just how the combustion men arrived at that ratio and how we arrived at practically the same thing, around 3½:1, instead of 5:1 on the ordinary engineering steels. I think that as early as 1930 when we first started to work with atmospheres, and with partially burned gases, gas burned at 2½ and 3, 4 or 4½ or 5 to 1, and there was complete combustion. I am speaking of coke oven gas now, and when we put that in the furnace, we reduced the hot rolled oxide. We had good, and we had poor and we had intermediate results. And so, I think we have made good progress for now, we have mostly intermediate and good results. We do not have poor results. We still have a long way to go. There is a big difference between a little furnace in the laboratory and one pretty near the dimensions of this room. Mr. Harris made some remarks as to the size of furnace, which entails long-time temperatures, twenty hours heating, 10 hours soak, 30 hours cool, 100,000 lb of bars or forgings going into a furnace at one time. It is tremendous. You just cannot help but have variables in a thing like that, so I wondered how they arrived at this 5:1 ratio.

A. H. Arbogast: There have been so many questions on atmospheres that I have tried to condense them to cover as much as possible in a few paragraphs. To answer all of the questions that Mr. Gifford and these gentlemen have asked us tonight, would really mean the preparation of another paper. The development of atmospheres in our plant had its beginning many years ago in the electric treatment, and Mr. Gifford must remember with some sorrow the results we had, not only with the steel we were treating, but with the furnaces.

We started out with straight coke oven gas, loaded with sulphur, containing 450 grains per 100 cu ft and proceeded to introduce this gas into the furnace to burn up the oxygen in the furnace atmosphere. We made a wonderful job of the heating elements in the furnace.

Later on we went into the development of the use of blast furnace gas, and in this gas we had no sulphur but had a very high CO_2 content. Although we had a high CO content we also mixed it with various hydrocarbons with varying degrees of success, and again had disastrous results with the alloy heating elements.

This experimentation continued for years until finally we put in atmospheric gas producers and started to see some light. We used these producers with desulphurized coke oven gas. We are handicapped in Bethlehem because we do not have natural gas. Our coke oven gas is sulphur laden and we have to desulphurize, so our results with coke oven gas burned in a generator depends on our efficiency of desulphurization.

We have continued using these producers for pit furnace atmosphere, but for the present development it was decided that we use pure nitrogen. So we ran many tests in the electric treatment department using various

grades of nitrogen. We found out what we could do with straight nitrogen and what we could not do with it. We found out what the oxygen and what the various grades of water meant in it. We also used it mixed with hydrogen and propane. In the preliminary tests we started to develop ratios and found that we could neutralize the oxygen carried in the nitrogen by the use of small quantities of propane. We were still somewhat undecided as to what effect this propane was going to have, inasmuch as it was being cracked under the inner cover.

With the development of the use of dry nitrogen and propane, we started to work out ratios that we knew we could use with certain steels. As previously stated, in order to give you an intelligent talk on the ratios of various steel analyses vs the ratios of various CO_2 ratios of nitrogen, would mean the preparation of another paper so let us suffice to put it this way:

The CO_2:CO ratio depends on temperature as well as on the carbon content of the steel and the protective non-ferrous metals alloyed in the steel. Some of these metals such as nickel and chromium may be protective. On the other hand, steels containing other metals have different characteristics.

We had been warned by good authority that any oxygen in the nitrogen would spoil our process. We have found that the nitrogen we use contains less than 0.5 to 3 per cent oxygen and can be handled with the use of 1 to 8 per cent propane, as we have explained here tonight.

Mr. Fisher asked the question why we use nitrogen and propane, instead of burning coke oven gas. We can burn coke oven gas or we can burn blast furnace gas and produce a satisfactory atmosphere, but the equipment involved together with the cost of operation would be beyond the amount we are now paying for this propane-nitrogen mixture because we require only a simple apparatus consisting of two rotometers to prepare this gas. We require no CO_2 absorption. We require no dryers. As received, this nitrogen is dried to minus 65 F, so we are justified in feeling that we have a simple mixture that is doing the job. We do not know how far we can go with it, but we are still working on it, and we will apply it to whatever extent it can be economically supplied and used, before continuing the development and further application of atmospheric gases generated from coke oven or blast furnace gas.

M. K. Morris: Mr. Eckardt was asking about the annealing process and the amount of carburization that takes place, and what we do to take care of the steel that has been carburized.

Carburization is very, very slight, and I believe Mr. Forrest mentioned this fact in his discussion. It amounts to 0.005 in. on a side and is not sufficient to cause any great concern. However, we must be constantly on the watch, to make sure we do not overcarburize.

Mr. Eckardt also asked about the six-hour soaking period and how we arrived at that time. If you recall from the chart, the base couples are exposed to the same atmospheres as the charge and the base couples take over the control of the heating cycle when the temperature has reached maximum. As a matter of interest, we checked our thermocouple temperature and our base temperatures with some couples buried in the charge, and we have established a differential from base temperature and charge temperature which has proven through practice to be very satisfactory.

Mr. Harris asked about the silica carbide refractory blocks. These are what we are using. It is a three section block.

Mr. Fisher wanted to know how we desulphurized coke oven gas. It is done with a tower and a sodium-carbonate spray, and the reason for desulphurizing is the analysis of the inner cover. We wanted to be sure we got the sulphur out so as not to cause grain growth of the nickel in the inner covers.

Mr. Fisher is correct in assuming the control is full-floating, and, as to the fuel rates, we have been able to obtain for a month's operation, fuel rates within the neighborhood of 300 lb of bituminous coal to a ton of steel produced. That is a month's average. The charge is 10,000 lb; the inner cover weighs 3,500 lb, and the cradle 3,000 lb, giving a total of 16,500 lb.

I believe Mr. Morris inquired about inner covers—the gage and the life. The thickness of the inner covers is $\frac{3}{16}$ in. The life has not been determined on the inner covers because the unit is comparatively new and we have not had any of the existing covers fail.

Mr. Campbell asked about end to end and top to top temperatures. It has been proven through tests that end to end and top to top are within plus or minus 10 degrees F. Analysis of inner covers is 25 per cent chromium, 12 per cent nickel. The initial covers that went into the operation were plain carbon steel inner covers. An oil seal is used in place of a sand seal because oil provides a more positive seal.

Mr. Spiess inquired about the luminous burners. We are not using that feature. The burners are available in the event they should become necessary when different stock is to be treated.

Mr. Schoen asked about comparative costs of annealing with atmosphere and without atmosphere. I am not prepared to give costs tonight. However, I can say that there has been a saving. This saving has been brought about by the elimination of pickling and wheelabrating.

The nitrogen and propane ratios have been determined experimentally.

Mr. L. G. Coscia requested the size of the inner cover. If you notice, the inner cover has several dimensions—the effective volume is 4 ft wide by 15½ ft long, by 3 ft 3½ in. high. There is no mechanical method for recirculating under the inner cover. The reason for the reversal of the flow under the inner cover is to cause circulation. The reversal cycle was determined from experience.

There was a question by Mr. Bye about cover pressures. We vary our controlled atmosphere pressures in the inner cover during the course of the heat, with a maximum pressure of 1 in. of water. The combustion atmosphere pressure at the hearth level varies from +0.18 in. pressure which we obtain when burning 5200 cu ft of gas an hour, and when burning gas at the rate of 100 cu ft an hour the pressure is then —0.02 of an inch at the hearth.

Mr. Horko asked for the analysis of the cradles and the inner cover life. The cradles are made of 25 per cent Cr and 12 per cent Ni steel. The inner cover life has not been determined due to the newness of the installation.

C. H. Williams

PRESIDENT, 1949

ASSOCIATION OF IRON AND STEEL ENGINEERS

C. H. WILLIAMS was graduated from the University of Colorado in 1926 and was employed by Jones & Laughlin Steel Corp. as shear foreman in their Pittsburgh plant. In 1927 he became a junior engineer in the power department of National Tube Co. at Pittsburgh, shifting in 1930 to the Ohio works of Carnegie Steel Co. Here he served successively as junior engineer, power and fuel engineer, and assistant chief engineer. In 1940 Mr. Williams was transferred to the Pittsburgh office of Carnegie-Illinois Steel Corp. as power and fuel engineer on the staff of the chief engineer, and was subsequently appointed assistant chief engineer of the Pittsburgh district. In 1941 he was placed in charge of a newly organized defense engineering staff to coordinate the engineering of defense steel plant expansions of the company in the Pittsburgh district. He was subsequently transferred to the United States Steel Corp. of Delaware as assistant to the vice president of engineering, and in 1943 to chief engineer of the Pittsburgh district, Carnegie-Illinois Steel Corp. He was appointed chief engineer of Carnegie-Illinois Steel Corp. in January, 1948.

The President's Message

We need not be able to forecast the precise pattern of coming business or political conditions to identify 1949 as another year of opportunity and challenge to the engineering and operating personnel of the steel industry, and of those other industries which serve it. Regardless of the particular turn of events, there will continue to be important and interesting problems for all of us and our Association to recognize, attack and solve.

Your Association accomplishes its main objective when it constructively assists its entire membership — now in excess of 3900 active, associate and junior members — by instigating and publicizing the latest practical and technical developments applicable to the industry we serve. Your Association can attain this end only in proportion as its individual members contribute to and cooperate in its varied activities.

Your 1949 officers and directors hope to merit a full measure of your constructive support and cooperation, so that we may together contribute to the improvement of the industry and the economy which we serve.

E. H. Williams

President, AISE

ALBERT S. GLOSSBRENNER
First Vice President

J. F. BLACK
Second Vice President

I. N. TULL
Treasurer

NEWLY ELECTED OFFICERS AND DIRECTORS

ASSOCIATION OF IRON AND STEEL ENGINEERS - - - 1949

ALBERT S. GLOSSBRENNER attended the University of Wisconsin and later entered the employ of the old Illinois Steel Co., one of the predecessors of Carnegie-Illinois Steel Corp., at the Gary, Ind. tin plate plant. He then transferred to the same company's South Works at Chicago as assistant foreman. Five years later he joined Youngstown Sheet and Tube Co. at Youngstown, Ohio, as assistant superintendent of the hot strip mill becoming superintendent about three years later. He was appointed superintendent of the Brier Hill plant in September, 1942, and in 1943 was named general superintendent of the Youngstown district of Youngstown Sheet and Tube Co. In December, 1946, Mr. Glossbrenner was named assistant vice president of operations.

JOHN F. BLACK received his elementary schooling in the Enid, Okla., city schools and attended the United States Naval Academy, class of 1926. He started in the steel business as pipefitter helper at Bethlehem Steel Co.'s Sparrows Point plant, progressing to steel shipper, labor foreman, gashouse foreman, general foreman of gas producers, combustion engineer, and general foreman of pipe mills. In 1941 he transferred to Atlas Steels, Limited, Welland, Ontario, as fuel engineer and in 1943 was made assistant works manager. In January 1947, Mr. Black was appointed general superintendent, Buffalo plant, Wickwire Spencer Steel division of the Colorado Fuel and Iron Corp.

I. N. TULL was born in Anniston, Ala., reared in N. C., and graduated from North Carolina State College in electrical engineering in 1910. After a brief period of telephone work, he entered General Electric Co.'s test course at Schenectady. He was transferred to their Cleveland office's engineering department in 1912, remaining there until 1915, when he was employed by Corrigan, McKinney and Co. as electrical engineer. The next 12 years were spent in engineering and construction work as that company built blast furnaces and a steel plant at Cleveland, Ohio and proceeded with extensive electrification of their iron mines and the opening of coal mines. In 1927, general supervision of electrical maintenance and operations was added to the construction duties. After the merger with Republic Steel Corp. in 1935, Mr. Tull became electrical superintendent of the Cleveland district for Republic.

JOHN L. YOUNG is a native of Evansville, Ind. and graduated from the University of Indiana. Mr. Young began his career with Timken Roller Bearing Co. in Canton, Ohio, where he held various positions in the alloy tube and steel departments; he later transferred to the metallurgical department. In 1930, Mr. Young went to Pittsburgh for Timken as a development engineer, and later returned to Canton and became assistant general manager of Timken's industrial division. Mr. Young joined United Engineering and Foundry Co., Pittsburgh, Pa., in 1936. In 1941, he was loaned as project manager to design and construct the Defense Plant Corp.'s aluminum rolling mills at Trentwood, Wash. He was vice president in charge of industrial research and development for United Engineering and Foundry Co., before assuming his present position as vice president in charge of engineering of United States Steel Corp.'s National Tube Co. in 1945.

E. L. ANDERSON has been associated with the iron and steel industry for over 30 years, having started in the electrical department of the Bethlehem Steel Co. at Sparrows Point, Md., in 1917. He was transferred to the Johnstown plant of Bethlehem in 1937, and was appointed superintendent of the electrical department of that plant in 1940.

ROSS E. BEYNON came from a family who originally were from Merthyr-Tydvil in Wales. His father was a bar mill roller and a roll turner. Mr. Beynon received his first experience working under his father in a roll shop and various rod and bar mills, starting at the age of 12. He studied mechanical engineering and drawing at home and worked a short while at drafting in industries other than rolling mills. He returned to the steel industry at Carnegie-Illinois Steel Corp.'s South works at Chicago, Ill. as roll draftsman. He became assistant superintendent and in 1931 became superintendent of roll department, the position he holds at this time.

JOHN L. YOUNG
Secretary

E. L. ANDERSON
Director-at-Large

ROSS E. BEYNON
Director

E. T. W. BAILEY
Director

H. W. NEBLETT
Director

JAMES D. O'ROARK
Director

E. T. W. BAILEY was born at Hawkesbury, Ontario, Canada, and received early education at Lakefield and Peterborough, Ontario, Canada. He graduated from the University of Toronto with a degree of bachelor of applied science in 1926. In 1932 he received the professional degree of chemical engineer from the same institution. After graduation he joined the staff of the Aluminum Co. of Canada, Ltd., Arvida, Quebec where he acted as assistant chief chemist. In 1928 he transferred to the engineering department of the Steel Co. of Canada, Ltd., in Hamilton, Ontario and some years later became head of their combustion engineering department.

H. W. NEBLETT was born in Charlotte, Tenn. where his elementary schooling was received. He received a B.S. degree in electrical engineering at the University of Tennessee, Knoxville, Tenn. in 1910. He began his career as designing engineer with Commonwealth Edison Co. in Chicago, Ill. In 1917 he became affiliated with Mark Manufacturing Co. as assistant electrical engineer. At Indiana Harbor, Ind., in 1920, he became electrical engineer, Steel and Tube Co. of America at Chicago. From 1922 to 1927 he was a consulting engineer on a project for Colorado Fuel and Iron Corp., Pueblo, Colo. From 1927 to 1932 he was president of Neblett Engineering Co., consulting engineers. In 1932 he was appointed special engineer, Inland Steel Co., East Chicago, Ind., the position he holds at this time.

J. D. O'ROARK was born in Broadway, Va. but received his elementary and high school education in the public schools of Covington, Ohio. He received his bachelor of electrical engineering degree from the Ohio State University in 1926. His initial employment consisted of four years on the test floor of the Westinghouse Electric Corp.'s East Pittsburgh works. From there he entered the employment of the Weirton Steel Co., Weirton, W. Va., first as electrical field engineer in construction and maintenance work, later as electrical maintenance foreman of the 54 in., 10 in. and 16 in. strip steel departments, and in 1947 became electrical superintendent.

R. L. HALL was graduated from Georgia Institute of Technology in 1931 with a degree in electrical engineering. In 1936, Mr. Hall was first employed as a co-operative student in the electrical department, Fairfield wire works, Tennessee Coal, Iron and Railroad Co., and later was transferred to the industrial engineering department. He was transferred, in 1939, to the electrical department, Ensley works, as assistant chief electrician, and at present is superintendent of the mechanical and electrical department, Ensley works.

WILLIAM N. HORKO was first an electrician with various electrical contractors in Philadelphia until 1921. He went to college preparatory at Brown preparatory evening school 1919-1921 and graduated from Drexel Institute in 1925 with a degree in electrical engineering. Mr. Horko went with General Electric Co. and United Engineers and Constructors, Inc., as an electrical draftsman. He then entered employment of Henry Disston and Sons, Inc., Philadelphia, Pa., in 1926 as electrical draftsman. In 1930 he was made furnace engineer in charge of all heating and heat treating equipment, which position is held at the present time.

PHIL E. HAGLUND, upon leaving high school, worked in the laboratory of the Oliver Mining Co. for about 8 years, finishing several courses in chemistry in the meantime. In the fall of 1914, he moved to the laboratory of the Semet Solvay Co., in Detroit, Mich. From the fall of 1915 until the present Mr. Haglund has been with the Ford Motor Co. in Detroit and Dearborn, Mich., serving in numerous metallurgical jobs in both iron and steel. He began in their laboratory from where he was transferred to the foundry and placed on their first electric furnace. The job led to larger and larger furnaces until one was built of 50-ton capacity. For a period of about 8 years he worked on electric furnaces, mostly on experimental and development work. Following this he was in charge of the iron melting department and, for a short while, served as assistant superintendent in the foundry. He left the foundry in 1926 and served as assistant superintendent and superintendent in the open hearth department until 1941. Since then he has had various duties in the field of steel metallurgy and at present is looking after the metallurgical end of making electric furnace rim steel.

R. L. HALL
Director

WILLIAM N. HORKO
Director

PHIL E. HAGLUND
Director

JOHN STOUFFER
Director

PAUL E. THOMAS
Director

PERCY J. BRITT
Director

JOHN STOUFFER is chief engineer with Republic Steel Corp. in the Youngstown, Ohio, district. Previous to going with Republic Steel Corp. in 1933. Mr. Stouffer was with Inland Steel Co., Arthur G. McKee Co., Koppers Co., and Westinghouse Electric Corp. He obtained his engineering education at the University of Maryland and Carnegie Institute of Technology.

PAUL E. THOMAS, chief engineer of Carnegie-Illinois Steel Corp., Gary steel works, Gary, Ind., was born in Indiana and graduated from Purdue University's school of electrical engineering in 1927. Mr. Thomas obtained his early steel mill experience working summer vacations at American Sheet and Tin Plate, Elwood, Ind. He was employed by the Illinois Steel Corp., Gary, Ind. in 1924 as a wireman and later as an electrical testing engineer, taking leave of absence to finish his senior year at Purdue University. In 1929 he left the steel industry to go with Byllesby Engineering and Management Co. as a design engineer and squad boss. From 1932 to 1936 he was employed by the city of Crown Point, Ind., in charge of construction of a water filtration plant. He again entered the steel industry in 1936 in the employ of Carnegie-Illinois Steel Corp., Gary steel works as a design draftsman design engineer and squad boss. From 1942 to 1944 he was assistant chief engineer and later acting chief engineer for Carnegie-Illinois during the construction and operation of the Gary armor plate plant. After this he was appointed assistant electrical engineer at Gary steel works, later became project engineer and in July, 1947 was appointed to assistant division superintendent of maintenance. In July, 1948 he was named chief engineer of the Gary works.

PERCY J. BRITT was born and educated in Syracuse, N. Y., where he was graduated from the Christian Brothers Academy (high school). Mr. Britt worked 18 years for Halcomb Steel division, Crucible Steel Co. of America, Syracuse, N. Y., starting as rolling mill clerk, then going to assistant foreman of bar mills, night superintendent, and superintendent of inspection and shipping departments. He then went to the Simonds Saw and Steel Co., Lockport, N. Y., for six years, as assistant superintendent. In April, 1947, he joined the Wickwire Spencer Steel division, Colorado Fuel and Iron Corp., as assistant superintendent of industrial relations with his headquarters in Buffalo, N. Y.

JULIUS E. GRAF was born in Pittsburgh and is a graduate of Carnegie Institute of Technology. After 28 years service with the subsidiaries of the United States Steel Corp., Mr. Graf became affiliated with Treadwell Co. in 1939. At the close of his service with United States Steel Corp., he became associated with the American Sheet and Tinplate Co Mr. Graf was chief engineer of that company at the time of the merger in 1936 with Carnegie-Illinois Steel Corp. After the merger, he became assistant chief engineer of the newly formed Carnegie-Illinois Steel Corp. In October, 1940, Mr. Graf was appointed assistant chief engineer of the Jones & Laughlin Steel Corp., Pittsburgh, Pa., the position he holds at the present time.

J. L. TATMAN was born in Portsmouth, Ohio, February 3, 1900. Mr. Tatman attended grade schools there and graduated from North High School, Columbus, Ohio. He attended the engineering school at Ohio State University. He later graduated from Massachusetts Institute of Technology with a B.S. degree in metallurgy. During summer vacations, he worked at blast furnace plants of the Shenango Furnace Co., Sharpsburg, Pa. and the Sharon Steel Hoop Co. at Lowellville, Ohio. After his graduation from MIT he worked in the blooming mill at Youngstown Sheet and Tube Co. in various recording capacities. He was then sent to the coke plant for a short period and worked on the batteries and in the by-product division. He was transferred to the Brier Hill division as a student engineer for approximately eighteen months, and was then placed as assistant superintendent of blast furnaces at Hubbard furnaces. He was returned to the Brier Hill plant as steam and combustion engineer, then to the sheet mill as assistant superintendent in charge of the finishing departments. In 1936 he became assistant superintendent in charge of rolling mills at the Edgar Thompson works, Carnegie-Illinois Steel Corp. He went to the Wheeling Steel Corp. in 1943 as assistant to the general manager and in February, 1948, was made blast furnace superintendent at the Steubenville-South blast furnaces at Mingo Junction, Ohio.

C. E. PRITCHARD was graduated from Carnegie Institute of Technology in June 1932. Upon graduation he joined the lubrication department of the Atlantic Refining Co., leaving in August, 1937 to join the mechanical department at the Warren district of the Republic Steel Corp. Here he served in the capacity of oiler and millwright until July 1938, when he assumed the duties of lubrication engineer of the Warren district. In March 1941, he was advanced to his present position of chief lubrication engineer of all Republic operations.

JULIUS E. GRAF
Director

J. L. TATMAN
Director

CHARLES E. PRITCHARD
Director

National Committees for 1949

ASSOCIATION OF IRON AND STEEL ENGINEERS

General Chairman, C. H. Williams

ADVISORY COMMITTEE

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1907-1908 JAMES FARRINGTON, *Electrical Superintendent*, Wheeling Steel Corp., Steubenville, Ohio.

1909 JOHN C. REED (Retired), Steelton, Pa.

1910 F. P. TOWNSEND, *Development Engineer*, Copperweld Steel Co., Glassport, Pa.

1914 E. FRIEDLANDER (Retired), Los Angeles Calif.

1919 D. M. PETTY, *President*, Philadelphia, Bethlehem and New England Railroad Co., Bethlehem, Pa.

1921 E. S. JEFFRIES, *President and General Manager*, Universal Boring Machine Co., Hudson, Mass.

1922 W. S. HALL, United Engineers and Constructors, Chicago, Ill.

1923 R. B. GERHARDT, United Engineers and Constructors, Philadelphia, Pa.

1924 R. S. SHOEMAKER, *Cincinnati District Manager*, Brooks Oil Co., Middletown, Ohio.

1926 G. H. SCHAEFFER (Retired), Reading, Pa.

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1931 F. O. SCHNURE, *Electrical Superintendent*, Bethlehem Steel Co., Sparrows Point, Md.

1932 J. J. BOOTH, *Superintendent of Maintenance*, Carnegie-Illinois Steel Corp., Duquesne, Pa.

1933 J. D. DONOVAN (Retired), Massillon, Ohio.

1935 W. H. BURR, *Electrical Superintendent*, Lukens Steel Co., Coatesville, Pa.

1937 *Chairman:* H. G. R. BENNETT, (Retired), Eustis, Fla.

1938 L. F. COFFIN, *Superintendent*, Mechanical Department, Bethlehem Steel Co., Sparrows Point, Md.

1939 C. CLARKE WALES, *Chief Project Engineer, Engineering Department*, National Tube Co., Pittsburgh, Pa.

1940 J. A. CLAUSS, *Vice President in Charge of Engineering*, Great Lakes Steel Corp., Ecorse, Detroit, Mich.

1941 W. A. PERRY, *Assistant to General Superintendent*, Inland Steel Co., East Chicago, Ind.

1943 F. E. FLYNN, *District Manager*, Republic Steel Corp., Warren, Ohio.

1944 CHARLES L. McGRANAHAN, *Assistant General Superintendent*, Jones and Laughlin Steel Corp., Pittsburgh Works, Pittsburgh, Pa.

1945 J. L. MILLER, *Assistant Chief Combustion Engineer*, Republic Steel Corp., Cleveland, Ohio.

1946 FREEMAN H. DYKE, *Manager of Operations*, Compania de Acero del Pacifico, Concepcion, Chile.

1947 L. R. MILBURN, *Chief*, Korean Power Mission, Seoul, Korea.

1948 A. J. FISHER, *Assistant Chief Engineer of Construction*, Bethlehem Steel Co., Bethlehem, Pa.

MEMBERSHIP COMMITTEE

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J. D. O'ROARK, *Electrical Superintendent*, Weirton Steel Co., Weirton, W. Va.

H. C. RODGERS, *Superintendent Finishing Departments*, Tin Mill, Youngstown Sheet and Tube Co., East Chicago, Ind.

S. C. EBBERT, *President*, Ebbert & Kirkman Co., Inc., Birmingham, Ala.

W. A. HOLT, *Assistant Superintendent, Mechanical and Electrical Departments*, Atlas Steels, Ltd., Welland, Ontario, Canada.

JAMES KING, JR., *Sales Engineer*, National Carbon Co., Niagara Falls, N. Y.

W. E. REIBER, *Assistant Chief Electrician*, Great Lakes Steel Corp., Ecorse, Detroit, Mich.

E. F. WEISS, *District Manager*, Cutler-Hammer, Inc., Detroit, Mich.

G. H. SCHAEFFER, JR., *Electrical Engineer*, Carpenter Steel Co., Reading, Pa.

C. P. HOLT, *Sales Engineer*, Westinghouse Electric Corp., Baltimore, Md.

E. F. CARY, *Manager Pittsburgh District*, Fast Coupling Department, Koppers Co., Pittsburgh, Pa.

A. G. ERICSON, *Chief Engineer*, Homestead Works, Carnegie-Illinois Steel Corp., Munhall, Pa.

J. H. FRANZ, *Superintendent Maintenance*, Ohio Works, Carnegie-Illinois Steel Corp., Youngstown, Ohio.

D. L. ORTON, *Vice President Charge of Sales*, Clark Controller Co., Cleveland, Ohio.

C. W. BRUCE, *Assistant Chief Engineer*, Republic Steel Corp., Chicago, Ill.

J. E. BRADY, *Switchgear Specialist*, General Electric Co., Chicago, Ill.

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L. J. GOULD, *Chief Engineer of Construction*, Bethlehem Steel Co., Bethlehem, Pa.

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(Chairman sub-committee on rolling pressures and power requirements for rolling mills)

J. E. BODOH, *Electrical Designer*, Carnegie-Illinois Steel Corp., Gary, Ind.
(Chairman sub-committee on crane wiring)

R. W. GRAHAM, *Electrical Superintendent*, Bethlehem Steel Co., Lackawanna, N. Y.
(Chairman sub-committee on crane limit switches)

F. E. KLING, *Chief Engineer of Special Projects Division*, H. A. Brassert & Co., New York, N. Y.
(Chairman sub-committee on design of hot metal ladles)

WILLIAM H. MURSCH, *Chief Draftsman*, Design Engineering Bureau, Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
(Chairman sub-committee on design of crane ladle hooks)

C. E. PRITCHARD, *Chief Lubrication Engineer*, Republic Steel Corp., Cleveland, Ohio.
(Chairman sub-committee on plain bearings; Chairman sub-committee on handbook of lubrication standards for the steel industry)

J. J. BOOTH, *Superintendent of Maintenance*, Carnegie-Illinois Steel Corp., Duquesne, Pa.
(Chairman sub-committee on steel mill lighting)

V. E. SCHLOSSBERG, *Superintendent*, Electric Power and Steam Departments, Inland Steel Co., East Chicago, Ind.
(Chairman sub-committee on mill motor brake standardization)

H. B. CONOVER, *Repair and Maintenance Engineer*, Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
(Chairman sub-committee on size, length, breadth and type of shunting for motor brushes)

E. C. McDONALD, *Combustion Engineer,* Republic Steel Corp., Cleveland, Ohio.
(Chairman sub-committee on content and amount of dirt in steel mill atmospheres)
H. W. NEBLETT, *Special Engineer,* Inland Steel Co., East Chicago, Ind.
(Chairman sub-committee on flexible and solid couplings)
E. L. ANDERSON, *Electrical Superintendent,* Bethlehem Steel Co., Johnstown, Pa.
(Chairman sub-committee on standard dimensions for enclosed switches)

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ROY P. TOOKE, *General Superintendent,* Armco Steel Corp., Butler, Pa.
JAMES N. IMEL, *Superintendent of Rolling Mills,* Jones & Laughlin Steel Corp., Pittsburgh, Pa.
A. D. HOWRY, *Assistant Superintendent Maintenance in charge of Electrical Department,* Alan Wood Steel Co., Conshohocken, Pa.
ALBERT J. GREENSLADE, *Plant Engineer,* Ohio Seamless Tube Co., Shelby, Ohio.
C. E. PRITCHARD, *Chief Lubrication Engineer,* Republic Steel Corp., Cleveland, Ohio.
H. S. HALL, *Fuel Engineer,* Lukens Steel Co., Coatesville, Pa.

ELECTRICAL ENGINEERING DIVISION

Chairman: A. D. HOWRY, *Assistant Superintendent Maintenance in charge of Electrical Department,* Alan Wood Steel Co., Conshohocken, Pa.
V. E. SCHLOSSBERG, *Superintendent, Electric Power and Steam Departments,* Inland Steel Co., East Chicago, Ind.
D. C. NELSON, *Assistant Electrical Engineer,* Jones & Laughlin Steel Corp., Pittsburgh, Pa.
C. E. HOMER, *Electrical Superintendent,* Youngstown Sheet and Tube Co., East Chicago, Ind.
R. W. GRAHAM, *Electrical Superintendent,* Bethlehem Steel Co., Lackawanna, N. Y.
JAMES D. O'ROARK, *Electrical Superintendent,* Weirton Steel Co., Weirton, W. Va.
J. H. FRANZ, *Superintendent Maintenance,* Ohio Works, Carnegie-Illinois Steel Corp., Youngstown, Ohio.
L. A. WYND, *Electrical Superintendent,* Republic Steel Corp., Chicago, Ill.

COMBUSTION ENGINEERING DIVISION

Chairman: H. S. HALL, *Fuel Engineer,* Lukens Steel Co., Coatesville, Pa.
EVERETT C. HITE, *Plant Engineer,* Steel and Tube Division, Timken Roller Bearing Co., Canton, Ohio.
C. E. DUFFY, *Fuel Engineer,* Bethlehem Steel Co., Sparrows Point, Md.
EDGAR A. HAWK, *Fuel Engineer,* Tennessee Coal, Iron and Railroad Co., Ensley, Ala.
E. T. W. BAILEY, *Combustion Engineer,* Steel Company of Canada, Ltd., Hamilton, Ontario, Canada.
GEORGE H. KRAPF, *Superintendent Power and Fuel,* Carnegie-Illinois Steel Corp., Munhall, Pa.
R. A. LAMBERT, *Superintendent,* Steam Efficiency and Combustion Department, Jones and Laughlin Steel Corp., Pittsburgh, Pa.
E. C. McDONALD, *Combustion Engineer,* Republic Steel Corp., Cleveland, Ohio.

OPERATING PRACTICE DIVISION

Chairman: ROY P. TOOKE, *General Superintendent,* Armco Steel Corp., Butler, Pa.
JOHN B. HILL, *Superintendent Blast Furnace,* Bethlehem Steel Co., Lackawanna, N. Y.
P. E. HAGLUND, *Supervisory Engineer,* Ford Motor Co., Dearborn, Mich.
ARTHUR K. BLOUGH, *Superintendent Electric Furnaces and Open Hearth,* Republic Steel Corp., Canton, Ohio.
JOHN S. STANIER, *General Superintendent,* Flat Rolled and Tubular Mills, Youngstown Sheet and Tube Co., Youngstown, Ohio.
T. M. FAIRCHILD, *Assistant to General Manager,* Bethlehem Steel Co., Johnstown, Pa.
DANIEL E. WISE, *Chief Engineer,* Carnegie-Illinois Steel Corp., Clairton, Pa.
RALPH H. GELDER, *Works Metallurgist,* Armco Steel Corp., Ashland, Ky.

ROLLING MILL DIVISION

Chairman: JAMES N. IMEL, *Superintendent of Rolling Mills,* Jones and Laughlin Steel Corp., Pittsburgh, Pa.
WADE F. HOFFMAN, *Superintendent Roll Department,* Jones and Laughlin Steel Corp., Aliquippa, Pa.
D. W. LLOYD, *General Superintendent,* Youngstown Sheet and Tube Co., Brier Hill Works, Youngstown, Ohio.
ANTON B. FROST, *Superintendent Roll Shop,* Kaiser Co. Inc., Fontana, Calif.
ROSS E. BEYNON, *Superintendent,* Roll Shop, South Works, Carnegie-Illinois Steel Corp., Chicago, Ill.
CHARLES HAMMOND, *Superintendent of Mills,* Rotary Electric Steel Co., Detroit, Mich.
F. G. KREDEL, *Superintendent Bar Mills,* Republic Steel Corp., Cleveland, Ohio.
H. A. CARTER, *Superintendent Roll Department,* Bethlehem Steel Co., Lackawanna, N. Y.

MECHANICAL AND WELDING DIVISION

Chairman: A. J. GREENSLADE, *Plant Engineer,* Ohio Seamless Tube Co., Shelby, Ohio.
PAUL L. WALTER, *Mechanical Superintendent,* Republic Steel Corp., Canton, Ohio.
JAMES J. HEALY, *Project Engineer,* Armco Steel Corp., Middletown, Ohio.
L. J. GOULD, *Chief Engineer of Construction,* Bethlehem Steel Co., Bethlehem, Pa.
PAUL F. KOHLHAAS, *Vice President,* Engineering Department, Columbia Steel Co., San Francisco, Calif.
R. E. BOBBITT, JR., *Chief Engineer,* Atlantic Steel Co., Atlanta, Ga.
EMIL KERN, *Chief Engineer,* Allegheny Ludlum Steel Corp., Brackenridge, Pa.
F. E. ROBINSON, *Division Engineer Project,* American Steel and Wire Co., Cleveland, Ohio.

LUBRICATION ENGINEERING DIVISION

Chairman: C. E. PRITCHARD, *Lubrication Engineer,* Republic Steel Corp., Cleveland, Ohio.
DONALD E. WHITEHEAD, *Lubrication Engineer,* Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
ANDREW CICHELLI, *Lubricating Engineer,* Bethlehem Steel Co., Sparrows Point, Md.
R. A. KRAUS, *General Millwright Foreman,* Republic Steel Corp., Chicago, Ill.
T. R. MOXLEY, *Superintendent of Maintenance,* Wheeling Steel Corp., Steubenville, Ohio.
WILLIAM M. SCHUCK, *Lubrication Engineer,* Armco Steel Corp., Middletown, Ohio.
D. N. EVANS, *Assistant Master Mechanic,* Inland Steel Co., East Chicago, Ind.

EDUCATIONAL COMMITTEE

Chairman: JOHN F. BLACK, *General Superintendent, Colorado* Fuel and Iron Corp., Buffalo, N. Y.
H. W. NEBLETT, *Special Engineer,* Inland Steel Co., East Chicago, Ind.
J. L. TATMAN, *Blast Furnace Superintendent,* Steubenville-South, Wheeling Steel Corp., Steubenville, Ohio.

ASSOCIATION OF IRON AND STEEL ENGINEERS

Constitution

Revised Sept. 11, 1918
Revised July 11, 1919
Revised Sept. 20, 1920
Revised Sept. 11, 1922
Revised June 23, 1936
Revised Jan. 1, 1940
Revised Jan. 1, 1949

ARTICLE I

NAME AND OBJECT

Section 1. Name — The name of this Association is the Association of Iron and Steel Engineers, hereinafter termed the Association.

Section 2. Object — The object of this Association shall be the advancement of the technical and engineering phases of the production and processing of iron and steel.

Section 3. Activities — To accomplish this purpose, the Association shall maintain a well balanced program of activities to inform its members of developments in engineering and operating practices in the iron and steel industry, and to appraise the value of these practices.

Among these activities shall be periodic meetings for the presentation of professional papers; research work; the establishing of standards for equipment; expositions; inspection trips; the publication of books, pamphlets and papers, including an official magazine known as the "Iron and Steel Engineer"; and other activities that may prove of advantage to the iron and steel industry.

ARTICLE II

LIMITATION OF ALLIANCE

Section 1. No permanent alliance of any kind shall be entered into by the Association, or any of its divisions or district sections, with any other association or society. No temporary alliance with any other society shall be entered into by any local section without the approval of the Board of Directors. No motion shall be entertained by the Board of Directors under this constitution which will actually or in effect accomplish an alliance which will in any manner or to any degree affect the purpose or fundamental principles of the Association as set forth in this constitution. However, the Association or its local sections may hold single joint meetings with any other engineering society, if in their judgment it is desirable.

ARTICLE III

MEMBERSHIP

Section 1. Qualifications of Membership — The membership of the Association shall consist of persons engaged in or identified with the engineering or operation of the iron and steel or allied industries, or with the application of equipment or service thereto.

Section 2. Classes of Membership — The classes of membership shall be four in number, namely, Honorary, Active, Associate and Junior.

Section 3. Honorary Members — Honorary members shall be persons who have rendered acknowledged eminent service to the iron and steel industry.

Section 4. Active Members — Active members shall be persons not less than 21 years of age, actively identified with or having responsible charge of technical, engineering, or supervisory work in the iron and steel industry.

Section 5. Associate Members — Associate members shall be persons not less than 21 years of age, actively identified with a company supplying equipment, material or service to the iron and steel industry, or identified with allied industries.

Section 6. Junior Members — Junior members shall be citizens of the United States or Canada, shall be persons identified with the iron and steel industry, shall not be less than 18 years of age, and shall not be eligible for membership under any other classification. After his 27th birthday, a junior member's classification shall automatically become active or associate. Yearly dues shall change accordingly, and no entrance fee shall be required to make the transfer. There shall be no foreign junior membership.

Section 7. Life Membership — An honorary rating of life member may be granted to active and associate members who have rendered acknowledged eminent service to the Association of Iron and Steel Engineers. This rating shall be given upon such terms and shall carry such privileges as may be set by the Board of Directors. This rating shall not affect the member's classification, which shall be decided by his qualifications, as set forth in the preceding sections.

Section 8. Change of Classification — In the event a member's status shall change so that he shall not meet the qualifications requisite to continued membership in his original classification, he shall automatically be reclassified according to his new status and qualifications. A member who has retired from all active employment in the iron and steel industry or with companies supplying equipment or service to that industry may continue in the membership classification he held at the time of his retirement.

Section 9. Admission to Membership — Admission to honorary membership shall require election by unanimous vote of the Board of Directors.

Admission to active, associate, and junior membership shall be by vote of the Board of Directors after application has been submitted in due form, and by payment of the required fees, as established by the by-laws.

Section 10. Rights of Members — Honorary, Associate, and Junior members shall be entitled to all rights and privileges of the Association except the right to vote and hold office. Only Active members shall have the right to vote and hold office.

Section 11. Fees and Dues — Membership entrance fees and dues shall be as provided in the by-laws.

Section 12. Resignation — Notice of resignation from membership shall be reported to the Managing Director of the Association, whereupon, if all dues and other indebtedness to the Association have been paid, the resignation in good standing shall be accepted and the person's name removed from the roll.

Section 13. Expulsion — Expulsion of a member shall be considered by the Board of Directors at the written request of ten members. Should there be sufficient cause, the accused shall be advised of the charges made and shall be given opportunity to make a defense before the Board of Directors. If satisfactory defense is not made, the accused may, by unanimous vote of the Board of Directors, be expelled from membership.

Section 14. Termination of Membership — Termination of membership in the Association, for any reason whatever, shall nullify all further rights and privileges in the Association and the use of all property thereof.

Section 15. Reinstatement — Reinstatement of members who resigned in good standing may be effected without payment of another entrance fee. The original date of election may be retained by payment of all back dues.

ARTICLE IV

OFFICERS

Section 1. Number — The officers of the Association shall consist of five members of active classification: President, First Vice President, Second Vice President, Secretary, and Treasurer.

Section 2. Terms of Office — The President and Vice Presidents shall serve for one year and shall not be eligible for an immediate re-election to the same office. The Secretary and Treasurer may be successively re-elected from year to year.

Section 3. Duties of the President — The President shall have general supervision of the affairs of the Association under the direction of the Board of Directors. He shall preside at the meetings of the Association and of the Board of Directors at which he may be present and shall be ex-officio a member of all committees.

The President shall appoint chairmen and members of standing committees as set forth in the by-laws, and may also appoint other committees as required.

The President shall keep the Board of Directors advised of the receipts and expenditures of the Association as given in the auditors' reports.

The President, together with the Secretary, or in the absence or disability of the latter, the Managing Director, shall sign all agreements and contracts made by the Association, after approval by the Board of Directors.

Section 4. Duties of Vice Presidents — The Vice Presidents shall assist the President, and, in order of their official rank, shall preside at meetings of the Association and Board of Directors in the absence of the President, and discharge his duties in case of vacancy in the office.

Section 5. Duties of Treasurer — The Treasurer, under the direction of the Board of Directors, shall have general supervision over the funds and accounts of the Association, shall act as Chairman of the Finance Committee, and shall perform all duties and services as set forth in this Constitution and these by-laws.

Section 6. Duties of Secretary — The Secretary shall himself, or through the Managing Director perform all duties and services as set forth in this Constitution and these by-laws, prepare the business for the meetings of the Association and of the Board of Directors, and record the proceedings thereof.

Section 7. Succession to Offices — A vacancy in the office of President shall be filled by the First Vice President. A vacancy in the office of First Vice President shall be filled by the Second Vice President. Any other vacancies shall be provided for by the Board of Directors for the unexpired term. Such succession to office or appointment by the Board of Directors shall not render an officer ineligible for immediate election to the same office at the next annual election.

Section 8. Salary of Officers — None of the officers above provided for shall receive, directly or indirectly, any salary from the Association, either as such officer or in any other capacity.

Section 9. Outside Interest of Officers — No officer shall be interested, directly or indirectly, in any contract relating to the operations conducted by the Association, nor in any contract for furnishing supplies thereto.

ARTICLE V

BOARD OF DIRECTORS

Section 1. Authority — The control of the affairs of the Association shall be vested in a Board of Directors in accordance with this Constitution and the general provision of the laws under which the Association is incorporated.

Section 2. Composition — The Board of Directors shall be made up of the President, First and Second Vice Presidents, Secretary, Treasurer, the two junior Past Presidents, a Director from each Engineering Division, a Director from each District Section, a Director-at-Large and such Honorary Directors as may be deemed desirable by the Board.

Section 3. Terms of Office — Directors and honorary directors shall serve for one year. Directors shall not be eligible for immediate re-election to the same office. Honorary directors may be re-elected to the same office from year to year.

Section 4. Duties — The Board of Directors, in addition to performing duties and services as set forth elsewhere in this Constitution and these by-laws, shall control the investment and care of the funds of the Association, and shall make appropriations for specific purposes. They shall approve the appointment of employees and the fixing of their salaries. They shall pass upon all applications for admission, and all expulsions. They shall provide an account under the control of the Managing Director for the purpose of paying petty bills, traveling expenses, and emergency bills.

Section 5. Adoption of By-Laws — The Board of Directors, subject to the provisions of this constitution, shall adopt by-laws which shall govern its procedure and that of its Officers, Committees and Managing Director. Such by-laws shall be adopted or may be amended by a two-thirds vote of the entire Board of Directors in person or in writing. The text of a proposed by-law or amendment shall be furnished in writing to each member of the Board of Directors at least ten days before the meeting at which a vote of the same is to be taken.

Section 6. Trustee — The Board of Directors shall appoint a reliable financial institution to act as Trustee for the funds of the Association. The Trustee shall invest such funds as may be ordered by the Board of Directors, and shall pay bills when approved by the President and the Managing Director.

The Trustee shall furnish to the President and the Managing Director a monthly financial statement of the funds of the Association entrusted to said financial institution.

Section 7. Quorum — Ten members, in person, shall constitute a quorum of the Board of Directors.

Section 8. Majority Vote — The "Vote of the Board of Directors" shall in all cases be the vote of a majority of the members present unless otherwise specified.

Section 9. Standing Committees — The Board of Directors may establish or suspend Standing Committees with such powers and duties as may be deemed necessary, in accordance with this Constitution.

Section 10. District Sections — District Sections may be established or suspended in such locations as may be deemed desirable by the Board of Directors. Government of District Sections shall be as set forth in the by-laws.

Section 11. Engineering Divisions — The Board of Directors may establish or suspend Engineering Divisions within the Association as may be deemed advisable.

Section 12. Board Meetings — At least one meeting of the Board of Directors shall be held annually, at which reports on the activities of the Association and its committees shall be given.

Other meetings may be called by the President, or upon written request of ten members of the Board of Directors. Notices of all meetings of the Board of Directors shall be sent to all members of the Board at least 14 days in advance of such meeting.

ARTICLE VI

MANAGING DIRECTOR

Section 1. The detail affairs of the Association shall be handled by a Managing Director under the supervision of the Board of Directors. Duties of the Managing Director shall be as provided in the by-laws.

ARTICLE VII

ELECTION OF OFFICERS AND DIRECTORS

Section 1. Qualifications — Officers and directors must be active members, elected by vote of the active membership of the Association as provided in this Constitution. They shall hold office for one year beginning the first day of January following the election.

Should an officer's or director's status change during his term of office so that he is no longer an active member, his right to such office shall cease and determine forthwith.

Section 2. Nomination — Nominees for offices and directorships shall be selected by a nominating committee composed of the President and the two junior Past Presidents sitting on the Board of Directors, and shall be approved by the Board of Directors.

Section 3. Election — The Board of Directors shall furnish the Secretary or the Managing Director the list of nominees for offices and directorships falling vacant not later than ninety days previous to date of the Annual Meeting.

The Secretary or the Managing Director shall mail the ballot on official form to all active members in good standing not later than 75 days before the date of the Annual Meeting.

Members not wishing to vote for the nominees whose names are printed on the official ballot, may substitute the names of any eligible members.

The voting shall be by secret letter ballot, the voter signing his name on an outside envelope and the ballot enclosed in an inner sealed and unmarked envelope. To be considered all ballots must reach the Secretary or the Managing Director 60 days before the Annual Meeting. The result of the election shall be announced at the Annual Meeting of the Association.

Section 4. Tellers Committee — The President shall appoint three active members, not members of the Board of Directors, to constitute a Committee of Tellers. The Managing Director shall deliver to the tellers, unopened, all ballots received by him, marking the outside envelopes received from members not entitled to vote, and the reason therefore. The tellers shall open only the envelopes that are not thus marked, and shall proceed in secret to count the votes received. All ballots and unopened envelopes shall be returned to the Secretary or the Managing Director, who shall preserve them for one month after the Annual Meeting. The tellers shall hand a signed report of the results of the vote to the President, who shall read this report at the Annual Meeting, and shall declare, duly elected, the eligible persons receiving the greatest number of votes for the respective offices.

ARTICLE VIII

BOARD OF ADVISORS

Section 1. Qualifications — There shall be a Board of Advisors composed of all living Past Presidents.

Section 2. Functional Status — The Board of Advisors may not of themselves originate any business or legislation, but can only act when called upon by the Board of Directors.

Any extraordinary affairs of the Association, such as changes of policy, changes in the purpose of the Association, and revision of the Constitution must be referred to the Board of Advisors by the Board of Directors. The Board of Directors may on their own motion refer to the Board of Advisors any business which they may deem advisable.

The Board of Advisors shall pass on all matters referred to them by the Board of Directors. Should the Board of Advisors fail to render an opinion on any question referred to them by the Board of Directors within 90 days from date of such request, the matter will automatically return to the Board of Directors for decision.

Should the Board of Advisors return a recommendation contrary to the opinion of the Board of Directors on any question submitted to the Board of Advisors, the question may, by vote of the Board of Directors, be submitted to the vote of the active membership of the Association.

ARTICLE IX

MEETINGS

Section 1. Stated Meeting — There shall be held an Annual Meeting of the Association for the transaction of such business as may be properly brought before it. The time and place of such meeting shall be fixed by the Board of Directors.

Section 2. Special Meetings — Other meetings of the Association may be held at such times and places as the Board of Directors shall select.

A special meeting of the Association shall be called by the President at the written request of one-fourth of the active membership.

Notice of all meetings shall be sent to all members at least fourteen days in advance.

Section 3. Quorum — A quorum of the Association shall consist of 10 per cent of the total number of Active members in good standing, either present or represented by proxy, or of 100 such members, whichever number is less.

Section 4. Proxies — Every member entitled to a vote at Association meetings may so vote by proxy. Every proxy shall be executed in duplicate in writing by the member himself, or by his duly authorized attorney, and one copy thereof shall be filed with the Secretary before the date on which it is to be voted. No proxy shall be valid after the expiration of eleven months from date of its execution, unless the member executing it shall have specified therein the length of time it is to be continued in force, which shall be for some limited period.

ARTICLE X

AMENDMENTS

Section 1. Method — Proposals to amend or revise the Constitution shall be by resolution of the Board of Directors, or by written communication to the Board of Directors, signed by not less than ten members in good standing. The amendment or revision as decided upon by the Board of Directors shall then be referred to the Board of Advisors not later than 180 days prior to the Annual Meeting for their approval. After being received by the President, from the Chairman of the Board of Advisors, it shall if approved be placed in the hands of the Secretary or the Managing Director not later than 90 days prior to the Annual Meeting. He shall send copies of it to all active members in good standing, not later than 60 days prior to the Annual Meeting.

Section 2. Evidence of Notice — The Secretary's or the Managing Director's affidavit of having mailed such copies shall be presumptive evidence of notice having been given.

Section 3. Voting — Ballots on amendments or revision shall be sent to the Managing Director in sealed envelopes so as to reach the main office of the Association at least 30 days prior to the annual meeting, and counted by a Committee of Tellers appointed by the President. If two-thirds of all the members voting declare in favor of the amendment or revision, same shall become a part of this Constitution and become effective the beginning of the next succeeding fiscal year.

Section 4. Limitation — No amendment to this Constitution shall abridge the term of any officer elected prior to the adoption of the amendment.

By-Laws

BY-LAW I

ADMISSION OF MEMBERS

Section 1. Application — Application for admission to membership shall be on a form prescribed by the Board of Directors, and shall embody a full record of the education and professional career of the applicant, and an agreement to comply with the constitution and by-laws of the Association. Forms shall be signed by the applicant and by three members of the Association.

Section 2. Waiver of Signators — Signatures of three Association members may be waived where conditions render them impractical, in which case the applicant shall give at least two engineers of recognized standing as reference.

Section 3. Failure to Fulfill Election — Any person elected to membership who shall fail to qualify by payment of the required fees within two months after notice of his election may be considered to have declined his election, and his election may be voided by the Managing Director.

Section 4. Non-Payment of Dues — Any member whose dues remain unpaid for more than six months after the date they are due may be suspended from the rights and privileges of the Association by the Managing Director, until his dues shall have been paid. If the dues of any member remain unpaid for a term of one year, the name of such defaulting member may be stricken from the rolls of the Association by the Managing Director.

BY-LAW II

DUES AND FEES

Section 1. Entrance Fees — Entrance fees for the various classifications of membership are as follows, payable in United States funds:

Honorary	None
Active — United States and Canada	$10.00
Active — Foreign	$10.00
Associate — United States and Canada	$10.00
Associate — Foreign	$10.00
Junior	None

Section 2. Dues — The annual dues for the various classifications of membership are as follows, payable in United States funds:

Honorary	None
Active — United States and Canada	$10.00
Active — Foreign	$12.50
Associate — United States and Canada	$10.00
Associate — Foreign	$12.50
Junior	$ 5.00

These dues include $5.00 as payment for a year's subscription to the official magazine of the Association.

If admission to Association membership is made after July 1, the dues for the balance of the year will be one-half of those set forth above, in which case the member shall not receive the yearbook for the year of admission.

Life membership, carrying exemption from dues payments, may be granted by vote of the Board of Directors in accordance with Article III, Section 7 of the constitution. Life membership is also automatically bestowed upon all Association members who have remained in good standing for 30 years.

BY-LAW III

MANAGING DIRECTOR

Section 1. Appointment and Contract — A Managing Director shall be appointed by the Board of Directors to handle the business of the Association as set forth in the constitution and by-laws, under the general supervision of the President and the Board of Directors, at a remuneration which shall be determined by the Board of Directors. The contract with the Managing Director shall be signed for the Association by the President and attested by the Secretary at the time of its execution, after being properly executed by the Managing Director.

Section 2. Duties — The duties of the Managing Director shall consist of managing all activities of the Association, the preparation of business for all national meetings of the Association, and the recording of the proceedings thereof. He shall have a seat on the Board of Directors, but no vote. He shall personally certify to the accuracy of bills and vouchers on which money is to be paid, before they are submitted to the President for approval. Under the general supervision of the Treasurer, he shall be responsible for keeping a record of the financial affairs of the Association. He shall submit a report compiled from the auditors' reports for consideration of the Board of Directors as soon as possible after the completion of the Association fiscal year. He shall supervise the Association's publications, superintend and manage Expositions and other programs sponsored by the Association, and arrange for technical sessions, under the general supervision of the Board of Directors. He shall receive all applications for membership and shall notify the applicant of his election or rejection, sending the applicant, if elected, a copy of the constitution and by-laws of the Association.

Section 3. Correspondence — The Managing Director shall be responsible for the proper conduct of the Association's correspondence and shall be furnished, by all committee chairmen, copies of such correspondence as they may handle directly for filing in the Association's records.

Section 4. Business Office — The Managing Director will have charge of the business office of the Association, and of the staff thereof, and shall maintain such an office force as may in his judgment be required to handle the affairs of the Association, subject to the approval of the Board of Directors.

Section 5. Moneys Due — The Managing Director will receive all moneys due and turn them over promptly to the Trustee, for credit to the Association's accounts. He shall report monthly all such deposits to the President and the Treasurer of the Association, who will acknowledge same.

Section 6. Bond — The Managing Director shall furnish a bond satisfactory to the Board of Directors.

Section 7. Seat on Committees — The Managing Director shall have a seat on all the standing committees as provided by the Constitution or by-laws.

BY-LAW IV

BOARD OF ADVISORS

Section 1. Meetings — Meetings of the Board of Advisors shall be at the call of the chairman of the Board of Advisors.

Section 2. Voting Limitation — No member of the Board of Directors, sitting on the Board of Advisors, shall have a vote on the Board of Advisors.

Section 3. Succession of Chairman — The first Chairman of the Board of Advisors shall be the senior living Past President, in point of service as President of the Association. He shall hold office for one year and then be succeeded by the next in rank of seniority, the succession to follow the same course from year to year.

Section 4. Method of Procedure — In submitting a question to the Board of Advisors, a written statement for each member, covering the matter involved with the reasons for or against, shall be sent under registered mail to the Chairman of the Board of Advisors. The statements shall be enclosed in addressed and stamped envelopes, unsealed, so that the chairman may insert any statement or suggestion regarding the question which he may deem advisable. After reviewing the subject each member of the Board of Advisors shall send his written and signed opinion to the chairman who shall hand the decision, as represented by the majority of the Board of Advisors, to the President of the Association to report to the Board of Directors at its next meeting.

The Chairman of the Board of Advisors shall, at any time upon request by the Board of Directors through the President, within 30 days after rendering an opinion, submit for the inspection of the Board of Directors all papers, including the individual opinions of its members covering the question.

BY-LAW V

STANDING COMMITTEES

Section 1. Names — The standing committees of the Association shall be the Executive Committee, Finance Committee, Meetings and Papers Committee, Membership Committee, Educational Committee, and Standardization and Research Committee.

Section 2. Responsibility — All committees shall be directly responsible to the Board of Directors and shall act under its direction. The Board of Directors may at any time require the President to remove any or all members of the committees and appoint successors. The term of the members of all standing and temporary committees shall be one year, subject to the above provision as to removal.

Section 3. Executive Committee — The Executive Committee shall consist of the officers of the Association and the two junior Past Presidents sitting on the Board of Directors. The President shall be chairman of this committee.

The duties of the Executive Committee shall be to develop further activities for the Association, to suggest new policies as activities expand and the organization grows, and, in general, to increase the effectiveness and usefulness of this Association to the iron and steel industry. The recommendations of this committee shall be submitted to the Board of Directors.

Section 4. Finance Committee — The Finance Committee shall consist of the Treasurer as chairman and two members of the Board of Directors to be selected by the President and approved by the Board of Directors. This committee, under the direction of the Board of Directors, shall have supervision of the financial affairs of the Association. It shall employ a certified public accountant to audit the accounts and submit a written report to the Board of Directors at least once a year.

Section 5. Meetings and Papers Committee — The Meetings and Papers Committee shall consist of the chairmen of the various engineering division committees, with the President as chairman. This committee shall act in an advisory capacity regarding the programs of meetings and conventions, editorial features of the official magazine, and such other publications as are deemed advisable.

Section 6. Membership Committee — The Membership Committee shall consist of three members of the Board of Directors. This committee shall pass upon all signed applications for Association membership and report its recommendations to the Board of Directors, which shall in turn act upon each application, after which the Managing Director shall notify the applicant of the result. The duties of this committee shall include the general supervision of increasing the membership of the Association.

Section 7. Educational Committee — The Educational Committee shall have general supervision of all educational projects authorized by the Board of Directors.

Section 8. Standardization and Research Committee — The Standardization and Research Committee shall have general supervision of all standardization and research work authorized by the Board of Directors. The general chairman of this committee shall appoint subcommittees according to the nature of each standardization project undertaken.

Section 9. Qualification of Committee Members — All committee members must be members of the Association, except where the specialized work of sub-committees may require the appointment of non-members.

BY-LAW VI

DISTRICT SECTIONS

Section 1. Officers — Each district section shall have a Chairman and a Vice Chairman. The officers shall be active members and in good standing at the time of their election.

It shall be the duty of the Chairman to take charge of the district section, to preside at all meetings of the district section and of the District Executive Committee. He shall have supervision and management of the district section and its property subject to approval of the Board of Directors. The District Section Chairman shall be Chairman of the District Section Executive Committee.

The duties of the Vice Chairman shall be to assist the Chairman in the discharge of his duties, to preside at meetings in the absence of the chairman, and discharge his duties in case of vacancy in the office.

Each district section shall have a Secretary appointed by the District Section Chairman, subject to the approval of the Board of Directors. He shall serve for one year or until his successor has been appointed and approved. District Section Secretaries shall be under the direction of the Chairman of the section and the President and Managing Director of the Association.

The duties of the District Section Secretaries shall be to attend to all correspondence and business in connection with operating the district section, subject to the approval of the District Chairman.

Section 2. Election of Officers — The District Chairman shall name three past chairmen of the section as a Nominating Committee, who will report their selection of candidates for Chairman and Vice Chairman at the last meeting of the fiscal year. Other nominations may be received from the floor. Voting shall be by ballot and the candidates receiving the majority of votes shall be declared elected. The Chairman and Vice Chairman's term of office shall be from July 1 to July 1.

Section 3. Executive Committee — The District Executive Committee shall be composed of the Chairman, Vice Chairman, junior Past Chairman, and three active members appointed by the Chairman.

The duties of the Executive Committee shall be to develop further activities for the district section and in general to increase the effectiveness and usefulness of the district section to the Association and to the iron and steel industry.

Section 4. Advisory Committee — There shall be a District Section Advisory Committee composed of all Past Chairmen of the district section.

Section 5. Papers Committee — There shall be a District Section Papers Committee composed of members appointed by the District Section Chairman.

The duties of the District Section Papers Committee are to secure authors, papers, movies, etc., for the meetings of the section.

Section 6. Meetings Committee — There shall be a District Section Meetings Committee composed of members appointed by the District Section Chairman.

The duties of the District Section Meetings Committee shall be to provide a place for the meetings of the section, and arrange for dinners and entertainment incident to the stated meeting.

Section 7. Reception Committee — There shall be a District Section Reception Committee composed of members appointed by the Section Chairman.

The duties of the District Section Reception Committee shall be to receive new members and guests, and to promote good fellowship between the district section members.

Section 8. Membership and Attendance Committee — There shall be a District Section Membership and Attendance Committee composed of members appointed by the District Section Chairman.

The duties of the District Section Membership and Attendance Committee shall be to secure new members in accordance with the requests of the Association's Membership Committee, and to stimulate interest in the district section meetings.

CANONS OF ETHICS FOR ENGINEERS

. . . . the board of directors of the Association of Iron and Steel Engineers has gone on record as approving the principles of this code and recommending that AISE members be guided by them . . . .

FOREWORD

Honesty, justice and courtesy form a moral philosophy which, associated with mutual interest among men, constitutes the foundation of ethics. The engineer should recognize such a standard, not in passive observance, but as a set of dynamic principles guiding his conduct and way of life. It is his duty to practice his profession according to these Canons of Ethics.

As the keystone of professional conduct is integrity, the engineer will discharge his duties with fidelity to the public, his employers and clients, and with fairness and impartiality to all. It is his duty to interest himself in public welfare, and to be ready to apply his special knowledge for the benefit of mankind. He should uphold the honor and dignity of his profession and avoid association with any enterprise of questionable character. In his dealings with fellow engineers he should be fair and tolerant.

PROFESSIONAL LIFE

SEC. 1. The engineer will cooperate in extending the effectiveness of the engineering profession by interchanging information and experience with other engineers and students and by contributing to the work of engineering societies, schools and the scientific and engineering press.

SEC. 2. He will not advertise his work or merit in a self-laudatory manner, and he will avoid all conduct or practice likely to discredit or do injury to the dignity and honor of his profession.

RELATIONS WITH THE PUBLIC

SEC. 3. The engineer will endeavor to extend public knowledge of engineering, and will discourage the spreading of untrue, unfair and exaggerated statements regarding engineering.

SEC. 4. He will have due regard for the safety of life and health of public and employees who may be affected by the work for which he is responsible.

SEC. 5. He will express an opinion only when it is founded on adequate knowledge and honest conviction while he is serving as a witness before a court, commission or other tribunal.

SEC. 6. He will not issue ex parte statements, criticisms or arguments on matters connected with public policy which are inspired or paid for by private interests, unless he indicates on whose behalf he is making the statement.

SEC. 7. He will refrain from expressing publicly an opinion on an engineering subject unless he is informed as to the facts relating thereto.

RELATIONS WITH CLIENTS AND EMPLOYERS

SEC. 8. The engineer will act in professional matters for each client or employer as a faithful agent or trustee.

SEC. 9. He will act with fairness and justice between his client or employer and the contractor when dealing with contracts.

SEC. 10 He will make his status clear to his client or employer before undertaking an engagement if he may be called upon to decide on the use of inventions, apparatus, or any other thing in which he may have a financial interest.

SEC. 11. He will guard against conditions that are dangerous or threatening to life, limb or property on work for which he is responsible, or if he is not responsible, will promptly call such conditions to the attention of those who are responsible.

SEC. 12. He will present clearly the consequences to be expected from deviations proposed if his engineering judgment is overruled by non-technical authority in cases where he is responsible for the technical adequacy of engineering work.

SEC. 13. He will engage, or advise his client or employer to engage, and he will cooperate with, other experts and specialists whenever the client's or employer's interests are best served by such service.

SEC. 14. He will disclose no information concerning the business affairs or technical processes of clients or employers without their consent.

SEC. 15. He will not accept compensation, financial or otherwise, from more than one interested party for the same service, or for services pertaining to the same work, without the consent of all interested parties.

SEC. 16. He will not accept commissions or allowances, directly or indirectly, from contractors or other parties dealing with his client or employer in connection with work for which he is responsible.

SEC. 17. He will not be financially interested in the bids as or of a contractor on competitive work for which he is employed as an engineer unless he has the consent of his client or employer.

SEC. 18. He will promptly disclose to his client or employer any interest in a business which may compete with or affect the business of his client or employer. He will not allow an interest in any business to affect his decision regarding engineering work for which he is employed, or which he may be called upon to perform.

RELATIONS WITH ENGINEERS

SEC. 19. The engineer will endeavor to protect the engineering profession collectively and individually from misrepresentation and misunderstanding.

SEC. 20. He will take care that credit for engineering work is given to those to whom credit is properly due.

SEC. 21. He will uphold the principle of appropriate and adequate compensation for those engaged in engineering work, including those in subordinate capacities, as being in the public interest and maintaining the standards of the profession.

SEC. 22. He will endeavor to provide opportunity for the professional development and advancement of engineers in his employ.

SEC. 23. He will not directly or indirectly injure the professional reputation, prospects or practice of another engineer. However, if he considers that an engineer is guilty of unethical, illegal or unfair practice, he will present the information to the proper authority for action.

SEC. 24. He will exercise due restraint in criticizing another engineer's work in public, recognizing the fact that the engineering societies and the engineering press provide the proper forum for technical discussions and criticism.

SEC. 25. He will not try to supplant another engineer in a particular employment after becoming aware that definite steps have been taken toward the other's employment.

SEC. 26. He will not compete with another engineer on the basis of charges for work by underbidding, through reducing his normal fees after having been informed of the charges named by the other.

SEC. 27. He will not use the advantages of a salaried position to compete unfairly with another engineer.

SEC. 28. He will not become associated in responsibility for work with engineers who do not conform to ethical practices.

Developments
IN THE IRON AND STEEL INDUSTRY
During 1948

By I. E. MADSEN

▲ 1948 was another year of full time production, of increasing pressure for more steel as well as a continuous scramble for raw materials and equipment to keep the industry going at capacity. There were, perhaps, no outstanding revolutionary developments during the year; there were, however, a continuous series of planned improvements, plant additions, and modifications to increase capacity and to produce better steel as well as to attain more efficiency in production. These changes, small as each individual one might be, increased the ability of the industry to produce steel economically more than any of the more spectacular developments such as the use of oxygen. At the same time, these changes were accomplished without loss of production or dislocation of the production pattern.

The year also showed an acceptance by the industry of the necessity for expansion which was a change from the position of the previous year. These expansions, however, are being developed in an orderly planned sequence by the industry itself so as to minimize shortages of materials for expansion and for the making of steel. The result of the national election will undoubtedly have an effect on the expansion program. Although risk capital in many industries may be discouraged, there is a group in the top governmental policy levels who undoubtedly will push for increased capacity if the industry itself does not see fit to provide such an increase, and legislation will undoubtedly be attempted to enable the government to sponsor additional capacity. This group in the government has been recommending an increase in capacity of at least 10,000,000 tons. Such an expansion would require a minimum of 2,000,000 to 3,000,000 tons of steel just to build it. In addition, such a program would also be somewhat dependent on developing additional sources of ore (12,000,000 tons per year) and at present prices would cost about $300.00 per ton or a total of $3,000,000,000. The Department of Commerce has estimated that a 10,000,000 ton expansion program would require annually 10,900,000 net tons of iron ore, 7,070,000 net tons of coke, 6,890,000 net tons of pig iron. Their estimate as to the finished steel required for this expansion are one and one-half million to two million tons of steel. The government also estimates construction costs at $250.00 per ton.

It is expected that by the end of 1949 the capacity of the industry will be about 98,000,000 ingot tons per year.

One significant trend in the industry is illustrated by the capacity of the Pittsburgh district which from 1945 to 1948 decreased from 22,521,000 to 20,829,000 tons or on a percentage basis from 23.58 to 22.10 per cent. On the other hand, the Chicago district increased on a percentage basis from 19.8 to 20.01 per cent. This is an indication of the gradual movement of the industry westward. There is one exception to the pattern; the Philadelphia district increased its steel capacity in the same period from 10,784,000 to 11,505,000 tons, thus raising its percentage from 11.29 to 12.21.

Steel productive capacity in the west increased during the year, not only in terms of actual tonnage but also on a percentage basis. The completion of the present program of western facilities will bring steel production up to about 3,000,000 net tons of finished steel annually, three times more than the 900,000 net tons which were available before World War II.

If additional capacity is built, one of the big problems will be where it should be situated. It is possible that the development of Labrador ore fields as well as fields in South America would make it economical to set this capacity on the eastern seaboard or the Gulf Coast. On the other hand, if the St. Lawrence Canal should go through, a site on the Great Lakes might give the most economical transportation cost for ore, limestone, and fuel, as well as proximity to the larger markets.

Typical of the expansion plans of the industry is one just announced by Inland Steel Co., who plan to increase ingot capacity from fifteen to twenty per cent without additional furnaces or mills. The increase will be accomplished by enlarging existing furnaces, rebuilding and strengthening buildings where they are located, by installing heavier equipment such as cranes, ladles, etc., and by expanding the use of oxygen in the open hearth. This company's capacity for the production of tin plate and other tin mill products will be increased from 4,000,000 to 6,000,000 boxes per year by the addition of new and more efficient facilities and the addition of an electrolytic tinning line.

Among the additional facilities which went into production during the year were two new modern blast furnaces which were blown in at the Carnegie-Illinois Steel Corp.'s South Works in Chicago. This company

Shown in the background are two of the newest and largest blast furnaces which were just put into operation at the South Chicago works of the Carnegie-Illinois Steel Corp. These two furnaces can each produce 1500 tons of iron a day and are part of United States Steel Corp.'s $875,000,000 post war development program.

also increased finishing facilities for silicon steel at Vandergrift, Pa., where two new continuous coil annealing lines went into operation. The Carnegie-Illinois Steel Corp. modernized some of their facilities at the Irvin Works thus increasing their cold rolled strip capacity. A similar increase was also made at Gary. A new coke oven battery installation was made at Clairton. The large construction program by the National Tube Co. which is going on at Lorain, Ohio was not completed during the year and will probably continue well into 1949. The National Tube Co. also installed additional tube-making facilities at Gary. At the Fairfield Works of Tennessee Coal Iron and Railroad Co., a hot rolled mill was converted to cold reduction. A new cold strip mill was completed by the Columbia Steel Co. at Pittsburg, Calif.

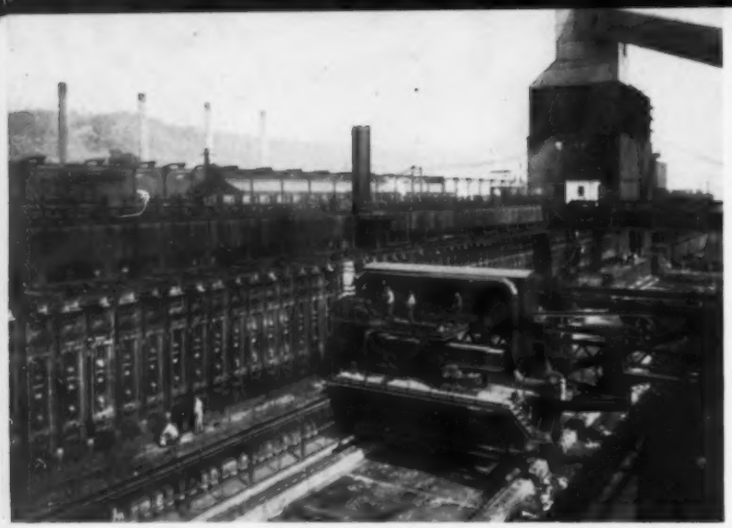
Most of the expansion program of the Bethlehem Steel Co. was completed. At Sparrows Point, a battery of coke ovens, a blast furnace, soaking pits, power station and new rolling mill equipment were installed. A coke oven battery and sintering plant were completed at Johnstown.

Republic Steel Corp. completed additional stainless steel cold finishing facilities at Massillon, Ohio, and also completed installation of top pressure blowing on several additional blast furnaces, so that five are now so equipped, including furnaces at Buffalo and Warren. A new pipe mill was also completed at Gadsden, Ala.

Jones and Laughlin Steel Corp. added a new open hearth at their Otis Works. They also announced extensive remodeling of their facilities in the Pittsburgh area and six new open hearths will be installed at the South Side plant and obsolete facilities will be taken out of production.

Wheeling Steel Corp. is reconditioning two blast furnaces at the Mingo plant which they purchased from Carnegie-Illinois Steel Corp. New coke ovens were also installed, and a new butt weld pipe mill was just about completed during the year.

One of the interesting changes in the industry seems to be a trend towards integration, making them less susceptible to shortages of component materials. The trend towards consumer-owned steel plants also continued during the past year with the sale of several independent plants to consumer companies. An example of this was the purchase of the Phoenixville plant of the Phoenix-Apollo Steel Co. by the Kaiser Co., Inc., in order to produce steel for their automobiles. In the



Orderly expansion of steel capacity necessitates expansion of raw material production for the making of steel. The photograph shows a new battery of 106 coke ovens which was completed at the Jones and Laughlin Steel Corp.'s Aliquippa works in 1948. New batteries have been and are now being constructed at a number of steel plants.

future, developments of this sort may occur in the electric furnace field because such units, carefully selected, can be shut down and started up much more economically than the open hearth, and thus they can match the ups and downs of end product production.

Among the consumers who obtained steel mill equipment is the Hudson Motor Car Co., which leased two-thirds of the former Shenango tin plate plant of Carnegie-Illinois Steel Corp. at New Castle, Pa. The Tucker Corp. attempted without success to get the DPC No. 5 furnace at Cleveland but this was leased by the Kaiser Co.

Both pig iron and steel capacity of the industry increased during the year. In December 1948, the American Iron and Steel Institute listed the first detailed statistics on the changes which have taken place in the steel industry since the end of the war. Steelmaking capacity as of January 1, 1948, was rated as 94,233,460 tons, which is an increase of about 3,000,000 tons from the beginning of the previous year. However, additional capacity came into being during the year and operating rates of 100 and slightly over 100 per cent during the later part of 1948 were due to a certain degree to this additional capacity. Blast furnace capacity on January 1, 1948 stood at an all time peak of 67,438,930 net tons, which exceeds even the war time high when many obsolete stacks were included in the figure. This was an increase of about one and three-fourth million tons compared with the previous year. On January 1, 1949, blast furnace capacity was about 70,500,000 tons, and steel capacity was about 96,000,000 tons.

Additional coke producing capacity was required before the additional blast furnace capacity could be utilized, and on January 1, 1948 coke capacity was 62,505,840 net tons for a new high. This increase in coke oven capacity was accomplished in spite of the fact that a number of beehive ovens had been taken out of service. As of a year ago, the remaining 3,790 beehive ovens in service had a capacity of 2,806,350 tons.

New figures for finished steel capacity also became available in the latter part of the year. These figures were based on the so-called practical method of compiling data which takes into account quantity of raw steel which is available. Hot rolled steel capacity is now given as 73,872,430 net tons as of January 1, 1948. The trend towards lighter steel products shows up in the increased capacity of the industry to produce sheets and strip, for which the capacity at the present time is 26,500,000 tons, 5,000,000 tons more than five years ago.

Steel production in 1948 established new peacetime records, with production for the year totaling about 88,500,000 tons. If it had not been for the coal strike in the early part of the year, it is possible that a new all-time peak would have been attained. Iron production in 1948 was about 59,000,000 tons, or 90 per cent of capacity. This compares well with the peak production of 62,072,683 tons attained during wartime 1944.

Shipments of finished steel for 1948 were about 65,700,000 tons. This compares well with a figure of 65,800,000 tons shipped in 1944, when almost 90,000,000 tons of ingots were produced. This trend is significant, as it indicates that the industry is attaining a higher yield, thus gaining the equivalent of additional capacity at no cost in terms of critically needed equipment or raw materials.

Production throughout the year was accompanied with the usual shortages of material, although scrap was in better supply than the previous year and coal quality was better. It is estimated that the industry in 1949 will produce about 68,000,000 tons of finished steel, out of a total ingot production of 92,000,000 tons, if no unexpected stoppages occur.

Steel demand continued strong, although towards the latter part of the year there seemed to be an inclination on the part of many consumers to get their supplies from regular sources and to avoid gray markets and high cost conversion deals. Unless the United States is involved in an extensive European rearmament program, the gap between supply and demand should be narrowed considerably in 1949.

The automobile industry held first place among industrial consumers of steel and approximately 15 per cent of the total shipments went to this industry. The construction industry took about 11½ per cent, rail transportation took 7.9 per cent and the oil and gas industry took a little over 6 per cent. Household appliances took about 3 per cent.

Steel prices continued their upward trend during the year and the composite steel price at the end of the year was about $95.50 a ton which corresponds to $76.09 one year ago. One item also which affected price was the fact that the industry changed from a gross ton to a net ton basis for quoting during the year. Scrap prices increased from $40,00 to $43.00. The composite pig iron price was about $46.82 per gross ton at the end of the year compared with $37.06 at the beginning of the year.

For the first time in the history of the steel industry a western mill announced prices which were at a parity with those of similar products produced in the east. This was done by a United States Steel Corp. subsidiary on May 1st.

Price increases were largely due to increases in operating and material costs. As an example, from figures reported in 1948, maintenance and repair changes in the industry were higher than ever before in history and $692,200,000 were spent in 1947 which was 41.3 per cent

higher than in 1946. This corresponds to $10.46 per ton of hot rolled iron and steel products.

One factor affecting steel costs was the growing scarcity of many non-ferrous raw materials. Aluminum, which in 1947 had started to catch up with demand again became a scarce item. One reason for this was the power shortage which reduced the production of ingots. Both copper and lead supplies became more critical and as a result the price of these two commodities increased during the year. Government stock piling was also a factor in these increases. Tin production increased during the year and its status remained about the same. Zinc supplies were tightened and this was particularly due to stockpiling.

One of the increasingly important trends in steel products in 1948 was the adoption of standards by the industry. The work of committees of the American Iron and Steel Institute in simplification of steel composition and products resulted in a number of standards being issued during the year. These standards were determined from tonnage studies on the order books of the steel companies, and their adoption enabled long tonnage runs of given commodities, thus helping to maintain a higher production rate than would have been possible if a larger variety of products were manufactured. A number of the national emergency low alloy steels were also standardized, and their production runs from ten to fifteen per cent of all the alloy steel products. Their use also is a result of the idea of specifying steel to hardenability limits rather than to chemical compositions.

One event which occurred during the year, although not a technical development, will undoubtedly have much more marked effect on the development of the industry than any other development for many years. This was the change in the pricing system which most of the industry saw fit to adopt after United States Supreme Court's ruling on the basing point system for the cement industry. Because of this ruling, steel producers adopted fob prices. As a result of this pricing system, when the demand for steel is slight and competition for markets become keen, the mill which is closest to the steel users will have an economical advantage over other mills. Unless otherwise influenced by raw materials and labor supplies, steel mill expansion and development will then be in areas where the steel is used, and as is now taking place, some users will move closer to their sources of steel supply. Areas such as Chicago and Detroit, where in normal times there is no appreciable surplus capacity for local markets, will have an advantage over areas such as Pittsburgh, where steel capacity is greater than local consumption.

Rail rates during the year continued an upward trend and, as a consequence, there was increased diversion of shipments to other forms of transportation, such as truck shipment and water-born shipments. Another factor in this change is the fob pricing system. At the present time, truck hauls are now crowding rail hauls up to lengths of 600 miles.

Steel production increases were worldwide, and Europe attained a much higher and more efficient level of operation. The industry in Great Britain is also operating at one of the highest levels ever, with a rate of 15,000,000 tons per year. A very important factor, however, in the future of the British steel industry is the nationalization program which was introduced by the labor government in a bill in November. This bill calls for the nationalization of over 107 companies accounting for 90 per cent of the industry, and would bring under public ownership everything from digging of ore to rolling of steel. The owners will be paid with British iron and steel stock which is guaranteed by the treasury both as to principal and dividends. Share holders will receive stock equal in value to the stock exchange quotation based on the October, 1948, average, or that of the six months just before the 1945 election, whichever is the higher. Essentially, the bill changes a privately owned industry to a publicly owned monopoly. The industry in England has estimated that if a high level of employment continues, a capacity of 18,000,000 tons would be a reasonable requirement in the early 1950's.

In India, a plan was formulated to increase capacity, and under study are two new plants which would have an annual ingot capacity of 500,000 tons each. The increase in India's steel capacity will also be accompanied by expansion in railway, cement, coal and oil. In addition, the short term expansion program in that country plans additional development at Jamshedpur of 150,000 tons, 100,000 tons in Bengal, 36,000 tons in Mysore and 20,000 tons Ichapore, West Bengal. This will be done by expansions and improvements to present facilities.

The Broken Hill Proprietary Co. is planning a new hot and cold strip mill in Australia. The company will have to double its ingot capacity at Port Kembla, New South Wales, in order to supply this mill. The new plant will be the first to produce tin plate in Australia.

Sintering is becoming more important in iron production. In this illustration the iron ore mixed with coal dust is ignited in a sintering furnace. It will emerge from the process looking like lumps of coke which can be used in the blast furnace.

In the expansion in France a new blast furnace has been ordered for Acieries de Longway. A new strip mill is also under construction, and another is now planned. A new company has been organized in Belgium called S. A. Compagnie des Fers Blancs et Tubes a Froid. This company plans to introduce American methods of cold rolling sheet and tin plate.

In Poland, in Lower Silesia, Russian equipment is being used in steel plant construction and it has been estimated that Polish output will be doubled when this program is completed.

An American engineering and construction firm is making a survey for the Columbian government of the possibility of establishing a steel industry in that country. This is a continuation of the trend in South America towards local steel plants.

BLAST FURNACES AND COKE PLANTS

Keeping the blast furnaces of the country going at capacity level was successfully accomplished because the ore suppliers were able to produce ores in the quantities, grades and qualities which were needed by the steel industry. The job was so well done that the carryover of winter ore stocks from 1948 to 1949 was about 2,000,000 tons larger than that in 1948 and over 82,000,000 tons of ore were shipped to Great Lake ports during the year. In spite of these huge shipments, the fear of depletion of high-grade ores was reduced somewhat because of developments during the year on processes to beneficiate low-grade ores, as well as by the discovery and proving of new ore supplies such as those in Labrador and Venezuela. Total ore consumption during the year was about 98,000,000 gross tons.

More activity was probably present in the ore mining industry than ever before in its history, particularly in the development of the large reserves of low-grade ores in the Superior area. Although there are perhaps between one and two billion tons of high-grade reserves in this area, which is enough for fifteen to thirty years' supply, these reserves will probably last much longer than that because future practice may blend these ores with the lower grades. Construction of plants to concentrate lean ore is just starting and they are the beginning of what will probably be a huge industry employing large numbers of men, using great quantities of power, and requiring great amounts of capital for the investment needed in the processing equipment.

The taconite ores run about 30 per cent iron. Some of these ores are magnetic, so that magnetic methods can be used for separation. The taconites which are not magnetic will have to be concentrated by other means, and flotation appears to offer the best possibilities. However, as a result of these processes, the ore is too fine for use and the powder must be sintered in order to be used in blast furnace. One method recently developed for sintering will reduce costs to about 80 cents a ton from the present average on the range of about $1.20 a ton. The method involves moistening the powder, and feeding it into a revolving drum that rolls it into pellets of iron These are then put in ovens where they become hard enough to be charged into the blast furnace. However, the methods finally adopted may differ a great deal from present methods because of new developments which may come out of the laboratories built during the past year. The Oliver Mining Co. just completed a new laboratory in Duluth, the Pickands, Mather & Co. is continuing the work which they started in the laboratory in Hibbing in 1941, and the Cleveland-Cliffs Iron Co. has a new laboratory under construction at Ishpeming. The M. A. Hanna Co. and the Jones & Laughlin Steel Corp. have both also finished new laboratories. A two million dollar experimental plant which will use the magnetic separation method at Aurora, Minn., was completed by Pickands, Mather & Co. This plant was designed to produce 200,000 tons of ore from taconite. The experimental unit built in 1945 by the Oliver Mining Co. treated about 350,000 tons of marginal ore during 1948.

In 1948 on the basis of an overall average, blast furnace ores had 50.42 per cent iron and 8.92 per cent silica. This compares with 51.80 per cent iron and 7.73 per cent silica in 1943. The trend has been gradual and uniform throughout this five year period. Sintering of ores has grown to a point where present sintering capacity is about 30,000,000 tons per year.

A large 4-unit beneficiation plant being contemplated is to be located near Beaver Bay on Lake Superior. It will be owned by the Reserve Mining Co. and managed by Oglebay-Norton & Co., and will be capable of producing ten million tons of taconite concentrate annually when all four units are completed. It has been estimated that the investment cost of the plant will run about $16 per ton of annual capacity and the project will take 4 to 5 years to complete.

In this plant the taconite will be fed to a primary crusher from railroad cars. It will then pass through secondary crushers, rod mills, magnetic separators, wash boxes, surge tanks, filters, and then to the agglomeration plant. The tailings will be poured into Lake Superior, and forty tons of water will be required for each ton of sinter. It has been estimated also that 60 to 70 kwhr will be required per ton of concentrate.

A great deal of work has been done in further developing ore supplies in the state of New York, and the indus-

The magnetic ores lend themselves better to methods of concentration and this photograph shows fine particles of magnetic iron ore being separated from waste material at an open quarry mine at Star Lake, N. Y.

try in the Adirondacks has taken a new lease of life. New York state ranks third in iron production in the country, and the ore is chiefly magnetic. Both open pit and underground operations are being done. The world's largest open quarry mine for magnetite ore has been opened at Star Lake, N. Y. Here at the Benson Mines, output was about 800,000 gross tons. Since the ores here are in a very hard rock, they must be blasted into pieces, and then processed in a crusher. They are then further pulverized through additional crushers and through rod and ball mills and then magnetic separators are used. The product is then sintered and shipped to the blast furnaces. A new pilot plant is also being constructed for concentrating non-magnetic ores.

A second steel company is also doing a great deal of work on rock-ores at Port Henry, N. Y. The average ores run about 35 per cent metallic iron and ores with as little as 22 per cent iron content can be profitably concentrated. Several old workings in the area around Caledonia are being re-explored and it is possible that new ore deposits may be located in the area. Some of the ore in that region is practically free from phosphorous.

The Bureau of Mines recently estimated that the potential reserves in Iron County, Utah, consist of 500,000,000 long tons of iron ore. About 100,000,000 long tons of this can be conservatively classified as having 40 to 50 per cent iron and the same content may be inferred to be contained in an additional 250,000,000 tons.

During the past year, a great deal of work went on in proving and exploration of the Quebec-Labrador deposit. This exploration indicates that these fields offer extensive reserves of high-grade ores running better than 60 per cent iron. Most of the initial exploration covers only those areas where surface indications were present which offered possibilities for open pit mining. The project will require a railroad about five hundred miles long to tidewater at Seven Islands, Quebec, where a harbor is available for the ocean-going vessels. Over 300,000,000 tons of ore proved so far show that the typical ore runs about 59 per cent iron, 1.50 per cent manganese, and 1.50 per cent silica.

Recent reports on the ore deposits in Minos Gerais, Brazil, indicate that the ore reserves here are much larger than ever previously estimated. One engineer claims that this ore is sufficient to feed the iron and steel furnaces of the world for the next 100 years. The ore runs from 60 to 70 per cent iron, is clean, reducible, free of moisture and can be moved and transported throughout the whole year. It is so located that it is only about twelve hours travel time from the ocean. A great deal of exploration work is still going on to determine the exact extent of these deposits.

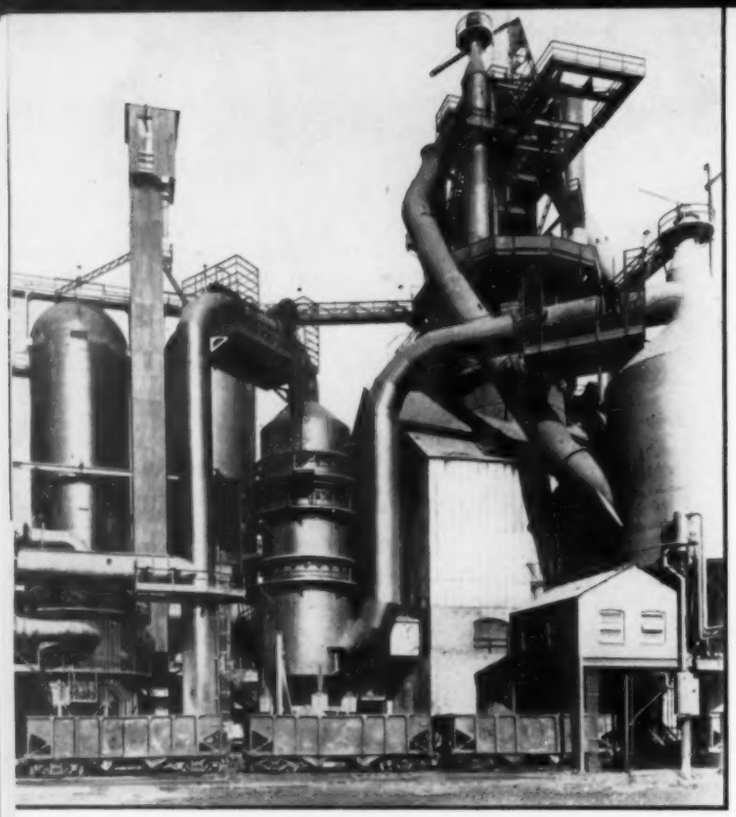
At Mina El Pao, 168 miles up the Orinoco River in Venezuela, new reserves have been developed consisting of a high-grade hematite ore which runs about 69 per cent iron, is low in phosphorous and free of vanadium and titanium. It is expected that shipping out of this area will begin by the end of 1949. A short railroad must be constructed as well as river transportation facilities. The recent revolution may alter some of these estimates. However in general, it is believed that the development of such mining operations in South America will help the national economies of the countries, and stabilize their governments.

Except during the period of the coal strike, adequate coal was available throughout the year for the industry. Because of the continued mechanization of the mines, coal quality as mined is gradually deteriorating, with ash and sulphur content on the increase. Hence, coal washing is being extended in the industry. However, research work sponsored by the coal industry tends to show that it is possible to use economically a higher sulphur coke in the blast furnace than has previously been thought possible. These preliminary conclusions are the result of a research program by the Coal Research Laboratory at the Carnegie Institute of Technology. The work also indicates that the rate of breakage is a better index of coke quality for blast furnace operation than the present test on coke breakage which is based on reduction in size. Under present blast furnace practice, coke is the item on which the closest control tests are constantly made. The other items which go into iron production, such as ore and limestone, are not constantly checked, with the result that coke is blamed for any variation in iron quality which may actually have been affected instead by variations in ore or limestone. If, on the other hand, the blast furnace is treated as a chemical retort with analyses made constantly on the limestone and ore as well as on the coke, such control would enable higher sulphur coke to be economically used in production.

Some coke plants felt that supplies of good quality coking coal were better during the year because of the substantial betterment of all coal supplies, and the increased use of coal washing equipment enabled better coal to be shipped even if the mined product was lower grade.

Heavy media suspensions are being used in the construction of a new large coal cleaning plant. The method is efficient in making preparations of coal which are high in impurities because it enables a separation of mate-

Separation of non-magnetic ores is a most difficult problem and shown here is an operation in a new pilot plant completed in 1948 at the Benson Mines, New York. The first of three stages of spiral concentration is illustrated where crude ore is carried down the spiral channels by wash water. The waste material is washed to the outer lip while the iron minerals work their way to the inner portion where they are tapped from the inside of the channel.



The favorable operating results being attained on blast furnaces with 10 psi top pressure indicate that results with 20 psi may be even more advantageous.

rials which have only slight differences in specific gravity, and this is the case for pure and impure coals. Heavy media suspensions employing water are used, as they are more economical than the usual heavy liquids. The method reduces coal loss, gives higher recovery and a cleaner product. This coal cleaning plant is designed to produce 18,000 tons of washed coal daily. More than 10,000 hp in electric motors is required to operate the plant.

A good deal of research is being sponsored on equipment to mine coal mechanically, and the bituminous coal industry launched a $250,000 program last year to design a machine that will mine coal cheaper and faster. The object of the program is to develop a machine that will cut coal from the solid vein without the use of explosives and load it continuously into a conveyor or mine cars. Two such machines were demonstrated during the year.

One of the new continuous mining machines can dig and load soft coal at a rate of three tons or more a minute. This machine is mounted on a low tractor and has ten rotating cutting heads attached to the front. These cutting heads chip the coal from the mine face and, as the machine progresses, the loose coal is carried to the rear and moved by conveyors to the cars. Inasmuch as a recent report of the Bureau of Mines indicates that the average thickness of the coal in the country is 65 in., there should be ample opportunity to use the machine.

The other new continuous mining machine was recently demonstrated, operating on a coal seam 60 in. thick, and in one operation ripped out the coal and loaded it into a hopper car. This unit can mine coal seams of 60 to 40 in. or less, while high models are available which will mine seams from 54 to 96 in. The machine is designed to mine two tons of coal per minute.

New blast furnace stacks completed during the year include those at the South Chicago Works of Carnegie-Illinois Steel Corp.; a new 1400-ton furnace for Youngstown Sheet and Tube Co. at Indiana Harbor; the Ford Motor Co. "C" furnace at the Rouge plant, and the Pittsburgh Steel Company's furnace at Monessen. The two idle blast furnaces at the Mingo plant were modernized by the Wheeling Steel Corp. and returned to production. These have been idle for some time. A new 1200-ton blast furnace will be built by Henry Kaiser at his Fontana steel plant.

Since 1944 there has been a drop in the production of pig iron per square foot of hearth area, ranging for six major producing companies from 0.04 to 0.33 net tons per sq ft per day. The average loss is about 8 per cent, or 80 tons per day for a 1000-ton furnace. This loss is largely due to the drop in coal quality over the years, and to virtual elimination of scrap in the blast furnace. Since 1944 coal consumption has increased about 3.2 per cent. Ash content is now running about 10.8 per cent. The limestone required as a consequence has been increased from about 778 to about 812 pounds per ton of pig iron produced.

Some of the outstanding production performances have been reached in blast furnaces in the far West. At one plant, a monthly average coke rate of 1360 lb per ton of iron was reached in one month, and seldom has a coke rate been over 1450 lb per ton. These results are credited to proper raw material preparation.

Blast furnace men are now talking about the 2000-ton blast furnace, and they estimate that this furnace is not far away. Such production will probably be attained by the use of beneficiated ores under close control. Permeability of ore charge, bulk of the charge, reducibility of the ore and uniformity of chemical and physical properties of beneficiated materials must be taken into consideration in order to obtain this rate. The blast furnace would need about three stoves, each with 333,000 sq ft of heating surface. The stove required would probably have a larger diameter than those in present practice, since the checkerwork must withstand its own weight and for this reason the height should not exceed 100 ft. Blowers must furnish enough air to burn 1700 lb of coke per ton of iron and 125,000 cfm air blowers would probably accomplish this result. Such a furnace would probably require a volume of 50,900 cu ft and as the retention time of the charge is 8⅓ hours, this will give a furnace with a hearth diameter of about 30 ft, a working height of the stack of about 86 ft, and an overall height of about 116 ft.

So far no results seem to be available in the United States on the use of oxygen in the blast furnace. One company, however, recently completed an oxygen plant, and the production of this plant will be used in blast furnace experimentation. Another company is building an oxygen plant which will be used in the blast furnaces as well as in the open hearth.

The use of high top pressure in blast furnaces continues, with seven furnaces now scheduled by one company for this operation. Another company also has started to convert two of its furnaces. One of the problems which accompanied high top pressure was exces-

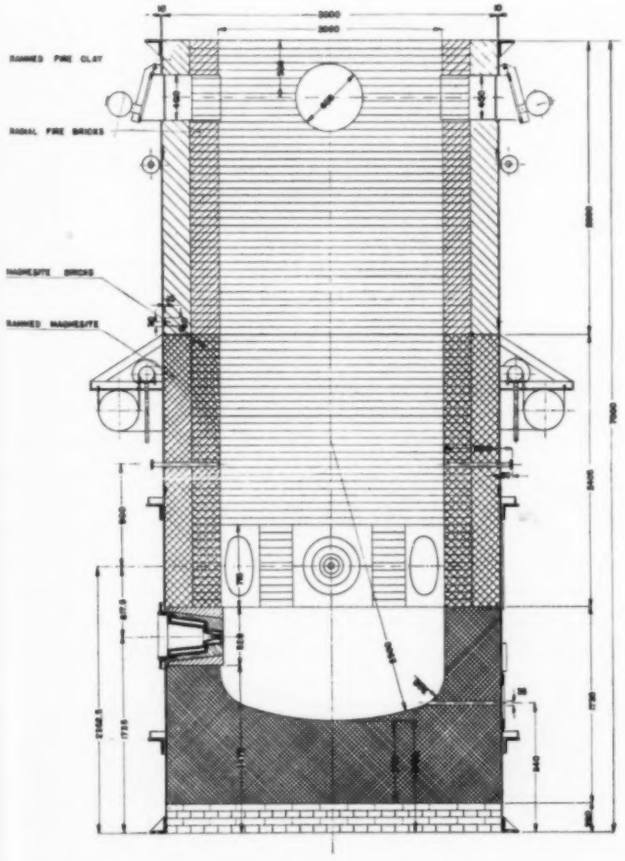
sive erosion of bleeder valves. It has been found that the installation of a clean gas bleeder will ameliorate this condition. When the furnace slips, pressure is relieved by the clean gas bleeder through switch relays.

Turboblowers which have been delivered during the year will enable furnaces to be operated at 20 psi top pressure, which should get better results than the 10 psi used in most high pressure installations. For existing plants where it would not be economical to replace existing blowers, booster blowers may provide the answer.

One of the most interesting examples of oxygen enriched blast in the German iron and steel industry was at the Suddeutsche Kalkstickstoff Werke in Trostberg. At this location a low shaft blast furnace was built. A low shaft furnace minimizes the cooling effect on the gases as they go up through the blast furnace. The gases cannot go below a low limit of approximately 212 to 250 F. When oxygen is added, because of the small amount of gas, cooling takes place more rapidly and in a low furnace oxygen content can be increased. A campaign lasting four weeks was run in this furnace producing pig iron. This campaign proved that the pig iron could be smelted successfully in such furnaces. Temperatures can be reached beyond those of the normal blast furnace (3350 F) and can go up to temperatures equivalent to those found in the electric furnace. It thus becomes possible to reduce metal oxides, which require the higher temperatures to iron ore.

Ores with lower contents of metals can be used economically. Lower grade fuels can also be used because of the low height of the furnace and low weight of the burden. In addition, the costs of lifting the burden 20 ft would be much less than those for lifting it 100 ft. The blast furnace gases also are of higher quality than those of the normal blast furnace.

Shown here is a section through the low shaft blast furnace at Trostberg reported in Fiat final report No. 1203. All dimensions are metric.



The trend in blast furnace linings is towards hard-fired refractories, superduty quality refractories, and carbon. The carbon is generally limited to the hearth. Superduty brick is generally being made of Missouri fire clays which fire to greater density than most other types. Actually, the fusion point is only about 20 to 35 F higher by actual measurement.

It is estimated that about 45 blast furnaces in the country now have some carbon in their hearth construction. The large carbon block is generally favored, with two layers forming the entire lining thickness. Operating results attained with carbon hearth linings still indicate that they will reduce breakouts, although there was a recent breakout in one lining shortly after it was installed.

In blast furnace stoves, a semi-silica type of refractory was more extensively used for domes, combustion chambers and top checkers. Jersey brick of this type was used for the first time in the Chicago district. The low alkali content permits this brick to withstand deformation better than regular brick.

An interesting detail developed for opening iron notches is called a jet caster. This has a projectile shaped top which contains a 2 oz charge of an explosive. The action is similar to that of a bazooka. If one shell does not bring the iron, a second charge is inserted in the notch and fired. It was estimated that a notch can be opened about $1.00 cheaper than by the use of the oxygen lance.

The blast furnace revolving distributor has been completely redesigned and the new distributor support is furnished by three 18 ft diameter rollers with hardened alloy steel rims instead of the six bottom supporting rollers previously used. Lateral stability is provided by three side rollers and the top is held down by three top rollers which duplicate the supporting rollers. The sealing arrangement has been changed and is completely independent of the bell seat.

STEELMAKING

The number of steelmaking furnaces in the United States as of January 1, 1948, showed an increase of 30 furnaces over the previous year. A total of 954 open hearth furnaces were in operation, with a total capacity of 83,610,690 tons. Thirty-nine bessemer converters, including ten which were used only for melting charges for open hearth furnaces were in production with an annual capacity of 5,226,000 tons. Electric furnace capacity was 5,396,770 tons with a total of 223 furnaces. Total capacity of the industry was 94,233,460 tons and this figure had increased appreciably by the end of the year.

Few companies in the industry were not experimenting with oxygen in one form or another in the open hearth. Practical limitations which showed up during the year made it evident that its use might not be as revolutionary as had been first indicated. There is no

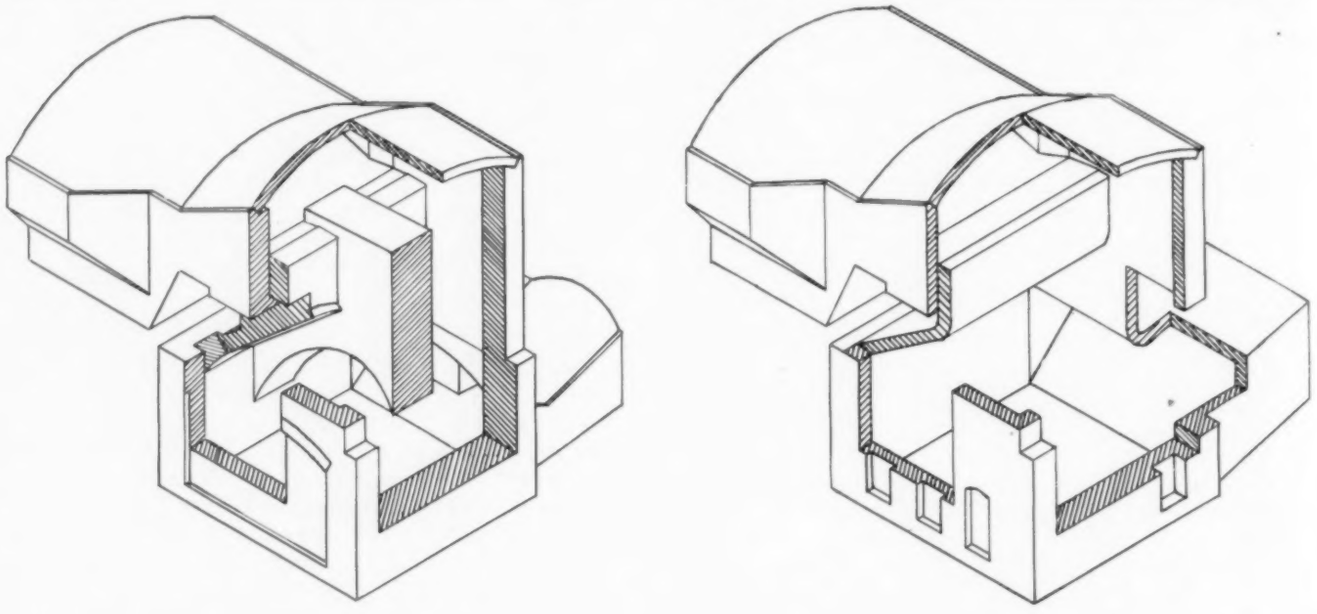
denying, however, that oxygen is a very useful tool. By its use an operator can adjust temperatures quickly, and also speed up particular heats to avoid bunching. Limitations in charging, however, prevent operators from taking full advantage of the speed-up. In addition, limitations in finishing facilities, soaking pits, etc., in the case of balanced plants, mean that there might not be too much point in speeding up steel production, with the additional existing costs which this might entail, until the capacity of the rest of the plant could be balanced with the increased ingot capacity. Up to the present, most oxygen applications are used for carbon reduction in the bath by the use of the lance. There is some evidence also that there is some sulphur reduction with its use.

The use of oxygen for combustion seems to have a bad effect on furnace refractories. There is a definite need for better refractories. Some users believe that super-duty silica brick will withstand both the additional heat due to the oxygen as well as the splash from the slag when the lance is used in the bath.

Some plants believe that the use of compressed air, particularly for the steels with relatively high carbon content, is more economical than oxygen. In one plant compressed air was used in a test run of 34 heats limited to 0.4 to 0.7 per cent carbon rimmed and mechanical capped grades of steel. Air pressure was 48 psi. A 9.6 per cent reduction in charge to tap time, because of a 22.4 per cent reduction in melt to tap time, was found for the heats made with compressed air and production increased 10 per cent in tons per melting hour. Two pipes are usually used per heat and there was some noticeable erosion.

Supplementing the work which was reported last year are the results of a complete series of tests at a steel plant in which 241 test heats were made in one furnace, using oxygen on 94 heats. These tests indicated that when oxygen was used in the burner, oxygen should be injected for about two hours, starting when the scrap was about one-half charged and ending at the start of the hot metal charging. This limitation gave no loss in time and resulted in substantial savings in oxygen. Tests were made with a relatively constant charge consisting of 60 per cent hot metal, 33 per cent scrap and 7 per cent metallic ore. Five different burners were tested and enrichment up to 33 per cent oxygen was used. However, no gain resulted from using over a 27 per cent enrichment, and this latter percentage gave heats which were on the average 20 per cent faster and showed a fuel saving of 10 per cent. There was no unusual refractory wear. The heats averaged about 200 net tons. A number of other heats were also made in this plant and five different furnaces were used for a total of 400 heats in the test program. Furnace charges ranged from all cold up to 60 per cent hot metal. The corresponding oxygen consumption ranged from about 1200 cu ft per ton for cold charges to about 600 cu ft per ton for high metal charges.

Multiple burners have also been used to decrease melt time, particularly when high scrap charges are used. In one design, one burner is placed on top of the other and both are used during the meltdown period. After the scrap is melted, one burner is shut off. In one plant where multiple burners and compressed air was used, the second burner was so pitched that the center line of the flames converged between second and third doors. In order to avoid sweating the roof, this plant also resorted to single firing at the time that the scrap became nearly level. The initial test results gave an increase of 0.48 net tons per melting hour or 5.1 per cent. or 0.42 tons per operating hour or 4.8 per cent. Compressed air was used from the beginning of charging



The conventional silica furnace is generally modified somewhat for conversion to basic construction. On the left is shown a cutaway section of the end of a conventional silica furnace and on the right is a cutaway view of the furnace converted to basic construction.

until the scrap was well melted down. About 275 cu ft of air at 100 psi were used and because of the compression the air has a temperature of 200 F at the furnace. It was introduced through a 1 in. pipe positioned directly under the burner with the open end of the pipe flush with the burner face. After a year's experience with the double burners and compressed air heats averaging 104 tons, the net effect was an increase in production rate of 15 per cent with a 4 per cent reduction in melting fuel, which averaged 4,672,000 net Btu per net ton of ingots.

One steel plant expects to increase the output of its steelmaking facilities about 20 per cent when its oxygen plant is completed. In addition to the oxygen, it has been necessary to modernize the auxiliary facilities such as ladle cranes, etc.

One of the factors necessary in speeding up the open hearth process is to reduce the charging time. One plant has found that proper preparation of light scrap, reducing the number of boxes from 200 to 80, results in a saving in the charging time of 1½ to 2½ hours. At this same plant the use of oxygen saves from 1 to 1½ hours per heat during meltdown and refining. Other means of meeting this problem are by the use of as large a charging box as possible and the installation of archless door frames and basic front walls to enlarge the opening. In order to speed up charging, some companies have considered opening up the front of the furnace and charging on a continuous grate chain charger full car loads of scrap.

Charge and feed ores deteriorated in quality during the year, but imports of Mexican, Chilean, Brazilian and Swedish ores eliminated some of this problem. Ore from the Steep Rock development will probably also help this situation.

A number of plants have installed cupola furnaces in their open hearth shops and thus minimized some of their raw material problems. In a typical cupola shop the iron which comes from the cupola has a relatively high sulphur content which may run up to 0.2 per cent. This may be reduced by adding soda ash to the iron in the ladle. The fluid slag which forms is removed and the metal then charged into the open hearth. Approximately 70 hours of operation is obtained before relining of the cupolas is necessary. Average yield runs from 94 to 97 per cent.

One cupola recently installed has such unusual features as water cooling of the bosh lining, increased blast pressure, a carbon paste well bottom and permanent bottom construction. This latter unit was designed for six months uninterrupted service between refractory repairs.

A good deal of work has also been done in the foundry industry on the use of oxygen in making steel. Oxygen has been used as additions in the cupola and experimental data report that with a 10 per cent oxygen addition and an 8:1 coke ratio, the melting rate is increased 20 per cent. Tapping temperature is about 100 F higher than with normal blast. By controlling the oxygen content and total volume of the blast, the tapping temperature and melting rate can be controlled to suit prevailing conditions. Oxygen contents of more than 10 per cent of the total blast require a low coke ratio and result in high tapping temperatures. The addition of 8 to 9 per cent oxygen to the blast will give operating conditions and temperatures similar to that with a 5:1 coke ratio even though the iron to coke ratio is increased to as much as 12:1.

The increased service which furnaces must withstand because of the use of oxygen, compressed air, etc., has led to a great deal of study of refractory performance. At the present time the AISI is engaged in standardization of terms so as to be better able to evaluate performance.

Open hearths with basic ends are being more widely used. At the beginning of the year, 14 furnaces were in operation with suspended basic ends and installations for 14 more furnaces were planned. One plant found an increase of 5 to 7 per cent in production because of reduced repair time. Repair costs were correspondingly reduced from three to five cents per ingot ton. Also, because of the increased production, there is a reduction of fixed costs of about 5 cents per ton. These savings will pay for the heavy initial cost of installation in a period of two to three years of operation. Some operators have claimed savings of from 10-25 cents per ton of steel produced by their use. A number of problems must be overcome before they are universally adopted. With basic end furnaces there is high air infiltration because of the expansion allowances. If basic refractories are used for both ends and roofs, it is necessary to have a completely suspended structure, a minimum of projecting corners or ends, joints tight enough to prevent hot gas penetration or cold air infiltration, metal encased brick, and sufficient provision for expansion to prevent buckling.

The all-basic furnace at South Works of Carnegie-Illinois Steel Corp. has had rapid erosion and slag accumulation at the port ends and up-take area. This is contrary to the reports given by some of the other installations, and is believed to be due to the high firing rates and high temperatures used on this furnace.

Another steel plant reported during the year that their operating experience shows that basic end furnaces are operated at a lower repair cost per ton than the conventional silica end furnaces. Their experience covers a period of four years and after 13,800 heats operating costs of the two types of furnaces were comparable, and at the end of 42 months the basic furnace cost was 11 per cent under the silica end furnace. One other effect noticed was that the fuel consumption per ton of product was lower on the basic end furnace than conventional silica end furnaces, probably because reduced repair time cuts the loss of stored-up heat.

A good deal of work was done on refractories during the year, particularly in an attempt to develop one which would better withstand the effect of the use of oxygen in combustion. This work has also resulted in further knowledge on the action of refractory disintegration. One new type of behavior studied by laboratory experiments has shown that the repeated alternate oxidizing and reducing conditions at 2200 and 2400 F causes a spongy growth in the iron oxide. This growth apparently occurs because of the conversion of one oxide to the other.

One super-duty silica brick which is now finding its way into installations has a maximum content of 0.5 per cent alumina, titania, and alkalis as compared with the

usual 0.9 to 1.4 per cent for the conventional silica brick. This slight difference in content, however, makes an appreciable difference in the resistance of the brick. There was a good deal of demand for premium priced super-duty silica brick during the year.

Some steel plants because of the good results obtained with the carbon hearth in blast furnaces, are considering carbon blocks to replace chrome brick below the rammed or burned hearth in the open hearth furnace.

Production of steel in bessemer converters, which for many years has been the second largest producer of steel, fell back to third place for the first time as electric furnace production overtook bessemer production. The side-blow converter, however, may offer an opportunity for bessemer production to attain second place again. At the present time a large steel company is experimenting with a 22-ton vessel. The operation of a side-blown unit is similar to that of a standard unit except that 15 to 20 minutes blowing time is needed instead of 10 to 12 minutes and the contact between the blast and metal is on the surface of the bath. As a result of the longer blowing time, there is better control of the blowing operation. The quality of the steel is better than that of ordinary bessemer steel and the initial cost is less than a standard bessemer of the same capacity. Blast pressure for the side blow unit is approximately one-fifth that of conventional converters or 4 to 5 psi.

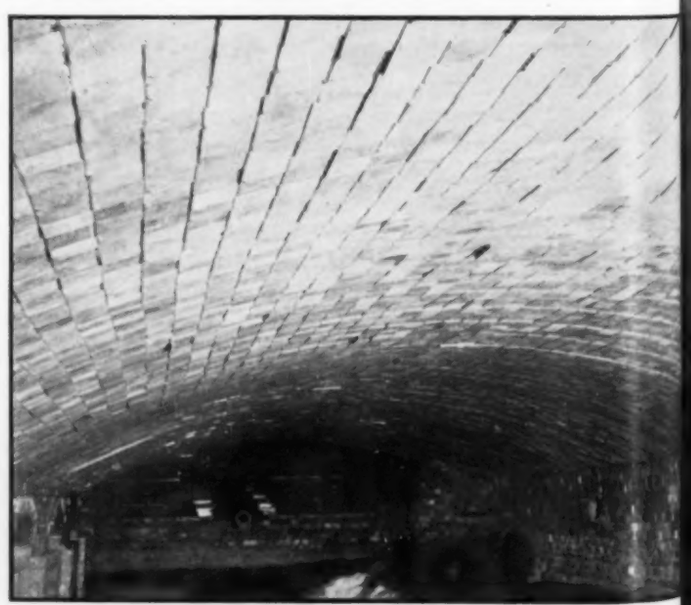
A great deal of test work has already been done on side blown converters in foundries in England and oxygen was used in the blow. These tests showed that a moderate enrichment of the blast reduced blowing time by one-half. This factor is not, however, important in foundries but may be important if this type of unit is used in production of steel plates. Another conclusion reached in the test program is that the quality of the product made with oxygen enriched blast is in no way inferior to that produced without the use of oxygen, and carbon contents were more consistent. As far as could be ascertained the oxygen had no bad effect on refractory life. High temperatures were obtained by its use.

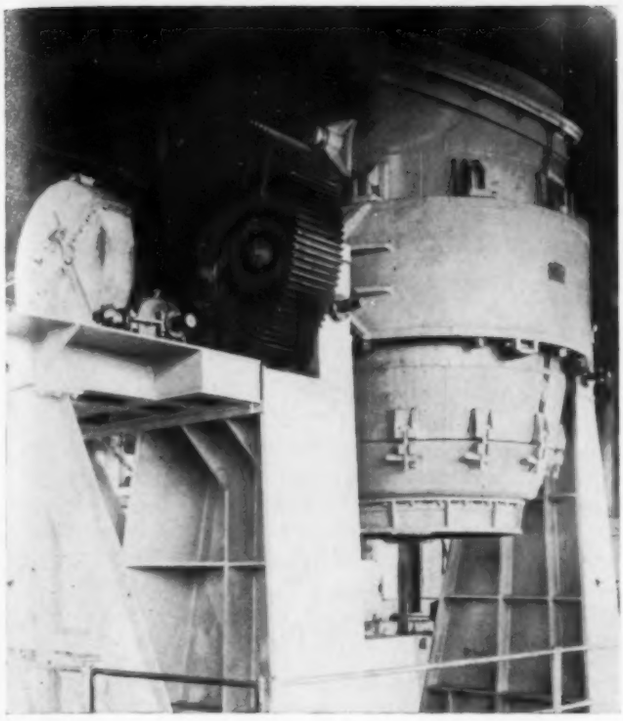
Other work on the use of oxygen in converters was reported last year by V. V. Konjakov on the results of a special converter plant which was built at the Kuznetsk steel works in Russia. Oxygen in concentrations of 50, 75 and 100 per cent was used. Results showed that oxygen blast could be applied to metal with a low silicon content, although further improvement is necessary in the reduction of phosphorus. Increased mechanical strength was obtained and the nitrogen content was very low. Oxygen consumption was about 1410 cu ft per ton of charge. The process needs further development in order to obtain longer service of the tuyeres.

Additional information was also obtained during the year on work done by the Germans. The so-called Maxhuette plant in Oberfalz, Bavaria, is so located that there is a great deal of scrap available. They therefore installed an oxygen plant to supply five converters, four of twelve-ton capacity and one of fifteen-ton capacity. The average converter life was about 150 heats, and that of the bottom was 45 to 50 heats. Their work indicated that most suitable concentration was 30 per cent oxygen. Greater concentration produced neither hotter nor a shorter blowing time. The procedure gave them high temperature and made it possible to add and melt 12 per cent more cold scrap. Large pieces of scrap as high as three tons were melted successfully in a ten-ton converter. In such cases, although a portion of the ingot was not melted at the time of the end of the first blow, it would be dissolved when the pig iron was added for the next blow. The process also allowed the use of pig iron with relative low contents of phosphorus. Cost savings were appreciable, although for other installations this will depend on the relative cost of scrap and pig iron. The operators estimate that one kilogram of scrap could replace one kilogram of pig iron for every cu meter of nitrogen which was eliminated from the blast. Because of the reduced blowing time it was possible to melt four heats per hour instead of three. The yield was increased to 87 to 88 per cent of the charge compared with 86 per cent yield without oxygen. Quality was improved and it was possible to manufacture deep drawing high silicon steels for dynamo and transformer sheets, apparently because of the low nitrogen content.

Experimental oxygen was used on a test program at one American bessemer converter where the metal is blown down to approximately 1.7 per cent carbon. The oxygen had a purity of 99½ per cent and a maximum oxygen content of 24.7 per cent was used in the converter. Twenty per cent more scrap than normal was charged and blowing time was reduced from 10 to 7½ minutes. Production was 37.5 per cent greater in terms of tons of blown metal produced per minute and this performance was reached with 258 cu ft of oxygen per ton. In another series of tests at the same plant, oxygen was turned on at the start of the blow at a rate of 1600 cfm for three to four minutes until the scrap was melted, and after the carbon blow the oxygen was again turned on for one or two minutes at a rate of 800 cfm in order to obtain a final silicon reduction. Results of this practice gave a good quality of blown metal with a clean, hot iron and a very good slag separation. Silicon was reduced from a normal of 0.10 to 0.006 per cent. Blow-

The main roof on number 16 furnace at the Steel Company of Canada is a radially suspended basic roof.





This new bessemer converter uses a maximum amount of welding in its construction. It is a 30-ton unit.

ing time was reduced from 9 to 6.34 minutes for a decrease of 29.5 per cent, and production was increased 40 per cent, or from 3.00 to 4.33 tons per minute. Oxygen consumption was 216 cu ft per ton. At this steel plant an oxygen plant with a capacity of 400 tons per day of 93 to 95 per cent pure oxygen is being constructed. The products of this plant will be piped so that they can be supplied to intakes of four turboblowers supplying cold blast to three 1200-ton blast furnaces, and also to a 400,000 cu ft storage bank. This in turn will supply oxygen to open hearth furnaces and to bessemer converters.

A new thirty-ton bessemer converter installed during the year is of welded plate construction. A minimum number of castings are used and in the case of the trunnion ring the trunnions are castings which are welded to the plate ring. Anti-friction bearings are used throughout with the exception of the trunnion ring bearings which are bronze bushed. Instead of cast teeth, the drive gearing has cut teeth.

Electric furnaces were the second highest producer of steel for the first time, principally because the shortage in open hearth steel led to the production of open hearth grades in the electric furnace. Also, alloy steel production for 1948 will probably exceed that of 1947 by 1,000,000 tons. The so-called triple alloy steels which contain nickel, chromium, and molybdenum were produced in greater tonnages than any other classes of alloy steels.

Some authorities feel that the large electric furnace may be highly competitive with the open hearth as a means of finishing hot, partially decarburized iron from the converter. This is because the electric furnace, for the same grade of production, is usually more economical than the open hearth except for power and electrode costs which in turn are largely dependent on the energy required for meltdown of the scrap charge. A liquid charge, close to temperature, cuts power and electrode costs down to a point where the electric furnace becomes competitive. One of the most important advantages of the electric furnace over the open hearth in high tonnage operation is the higher temperature, which makes it possible to melt scrap at almost any desired speed, and to heat it several hundred degrees hotter than the usual working temperature in the open hearth.

It may be said that the so-called 70-ton furnace is the standard large unit today. This furnace has on the average a 20-ft inside diameter on the shell, has a flat bottom, and is mounted on rockers. It will have a holding capacity of about 175,000 lb. These furnaces use either a 12,500 or 15,000 kva transformer equipped with a wide range of secondary voltage controlled by a multiple position tap changer.

A number of additional furnaces were installed during the past year or are scheduled for completion during the first part of 1949. At one plant these facilities included two 70-ton electric melting furnaces as well as one 60-ton melting furnace. The furnaces on order will be able to turn out about 600,000 tons of steel annually, and when they are all installed at the end of 1949, electric furnace capacity will be increased about 12 per cent. Most of these furnaces are scheduled for high carbon steel production. In 1948 approximately 60 per cent of the steel produced in the electric furnace was carbon steel.

Oxygen instead of iron ore for an oxidizing agent is becoming standard practice in making electric steel. The oxygen is used in the electric furnace to perform three functions: remove carbon, control bath temperature, and melt scrap. In one method the oxygen is introduced slightly below the slag metal interface by an iron pipe lance. In another method, a water cooled nonconsumable tool is used to direct the oxygen through the slag into the metal. Experience in the electric melt shop shows that the use of oxygen increases tons per operating hour, improves alloy steel quality, and results in cost savings which are most apparent in manufacturing stainless steel. The cost saving in this latter case is largely due to the larger quantities of stainless steel scrap which can be charged. There is also an improved recovery of chromium from the stainless scrap.

Methods of improving yield have continued to receive considerable attention. An installation of electric hot tops was made in a plant devoted principally to specialty steels. On 9 in. sq ingots the method has given yields ranging from 92 to 96 per cent. In the process, heat is applied to the top of the metal teemed in an ingot mold while the teemed metal is covered by a protecting blanket of flux. The heat is supplied at such a rate that a reservoir of highly heated molten metal of gradually diminishing size is available to feed to the solidifying metal underneath as volume change takes place. An installation consists of a source of power and a liquid-cooled, non-consumable, non-contaminating electrode.

Other procedures receiving some attention are a mold-shaker and a punching and upsetting operation. In the former, the mechanism is mounted on a narrow gage track, and jolts the mold at a frequency of 24 to 50 times per minute until the ingot is about 75 per cent

In the first step of the continuous casting process molten metal is poured from the transfer ladle into an induction furnace from which it will be poured into a tundish which is designed to strain out the slag.

solidified. An increase of about 2 per cent in yield from rimmed steel ingots is claimed. In the latter process, the steel is poured into big-end-up molds with a taper several times that normally used on hot top ingots. The ingot is then placed in a cast iron holding die and a hollow tapered punch is driven into the top of the ingot and into the segregate. In the next step, the steel surrounding the segregate is driven down past the bottom of the segregate, and in the last step the ingot is removed from the holding die and forged to a size suitable for the blooming mill. With a scale loss of 3 to 4 per cent, a bottom crop of 2 to 3 per cent, and top crop of 14 to 5 per cent, a blooming mill yield of about 90 per cent can be obtained.

Continuous casting caused a great deal of furore in the past year, and the method is being used experimentally at a steel plant producing billets for seamless tubing. As now operated, the casting unit casts two or three times a week. The casts are both alloy and carbon steel. The equipment is housed in a vertical 75 ft tower. Molten steel is carried to the top of the tower by means of transfer ladles, which are then emptied into an electric induction ladle. The steel then passes into a tundish and then into a water cooled mold. The billet which is now chilled, goes down through an insulating sleeve at a speed controlled by pinch rolls. An automatic acetylene torch cuts the billet to desired lengths which are lowered to a horizontal position. Experience has shown that the faster the casting rate, the better the resulting surface. However, the metal must be brought in contact with the mold when the metal is at optimum viscosity.

The method offers possibilities for the production of small billets which can be used directly for rolling some products, and may eliminate in such cases the use of ingot pouring facilities and soaking pits as well as the blooming mill. The method is still experimental, however, and much work must still be done before the process becomes a commercial procedure.

A method for making small ingots of high grade specialty steels uses an electric arc for melting the various materials under a slag blanket. The ingot may be of any desired size or analysis, and is produced by progressive solidification as alloying elements are fed at a controlled rate directly into the mold from which air is excluded. A tube is formed from cold rolled strip which becomes a consumable electrode and is melted in the mold by the arc. Inside the tube a smaller tube conducts alloy elements to the arc where they are liquified and distributed in the bath. The ingot or billet is produced in a copper water cooled shell. Solidification starts at the bottom and as the ingot grows the mold is pulled down so that the arc stays at the same spot. Melting speed for a single ingot machine is about 7½ lb per minute. Ingots now being produced are 6 ft long with 11 in. maximum or 4 in. minimum dimensions. This method should not be confused with the electric hot top process.

ROLLING

A number of plants are increasing cold rolling capacity because the demand for such products continues strong and by the end of 1948 the steel industry was able to make 21,000,000 tons of sheet and strip, an all-time high.

The trend to faster rolling mills increased and five 5-stand tandem tin-plate mills having maximum speeds over 4000 fpm were installed during the year. One five-stand tandem cold strip mill has a top speed of about 6000 fpm or 70 mphr. This particular mill is driven by twin motor drives, but with no idler pinion connecting the top and bottom roll. Synchronization is accomplished entirely through electrical control.

This mill has 16,500 nominal hp in the drive motors. There are two 10,000 hp motor generator sets, each with three generators. The mill will roll strip up to 36 in. wide and will finish to gages of 0.008 in. and less from strip up to 0.109 in. thick. When rolling at 6000 fpm, a 15-ton coil can be rolled into tin plate in about five minutes.

The control system used in the mill is an improved version of the rotating regulator which was used in the gunnery control system of the B-29 bombers. The regulator maintains the proper speed relationship between the various mill motors. By means of the control, the mill can be accelerated from 300 fpm to 4500 fpm in six seconds.

This mill is the first tandem mill to have individual roll drives on the last three-stands and the first mill to have rotating regulator controlled screwdowns. The screwdowns have the fastest response and speed of operation of any tandem mill. A separate generator for each stand increases the flexibility of operation. Generator voltage control is used as well as modern field control to adjust between mill stands. It is also the first mill on which X-ray equipment has been regularly used for finish gage.

A new development in rolling mills is a 4-high reversing cold strip mill in which the back-up rolls are driven, with the strip under relatively high tension. The results of the operation of a small 10 in. pilot mill show that reductions can be made on 18.8 stainless, 3.5 per cent

Si, and 1.25 per cent C steels which approach those considered normal for low carbon steel on the present conventional 4-high mill. Trial reductions of up to 59 per cent were made without slippage between the rolls. Production is said to be three to ten times that of a similar size mill of the all-pull type when rolling the thinner gages. High silicon steel has been rolled from 0.025 to 0.010 in. and low carbon steel from 0.020 to 0.006 in. three passes. A larger mill of this type is now under construction.

Temper mills are also becoming faster and at the present time a 42 in. 2-stand mill is being built for 5000 fpm. This mill incorporates all the latest features in electrical equipment and nearly matches the output speed of the fastest tandem cold reduction mills.

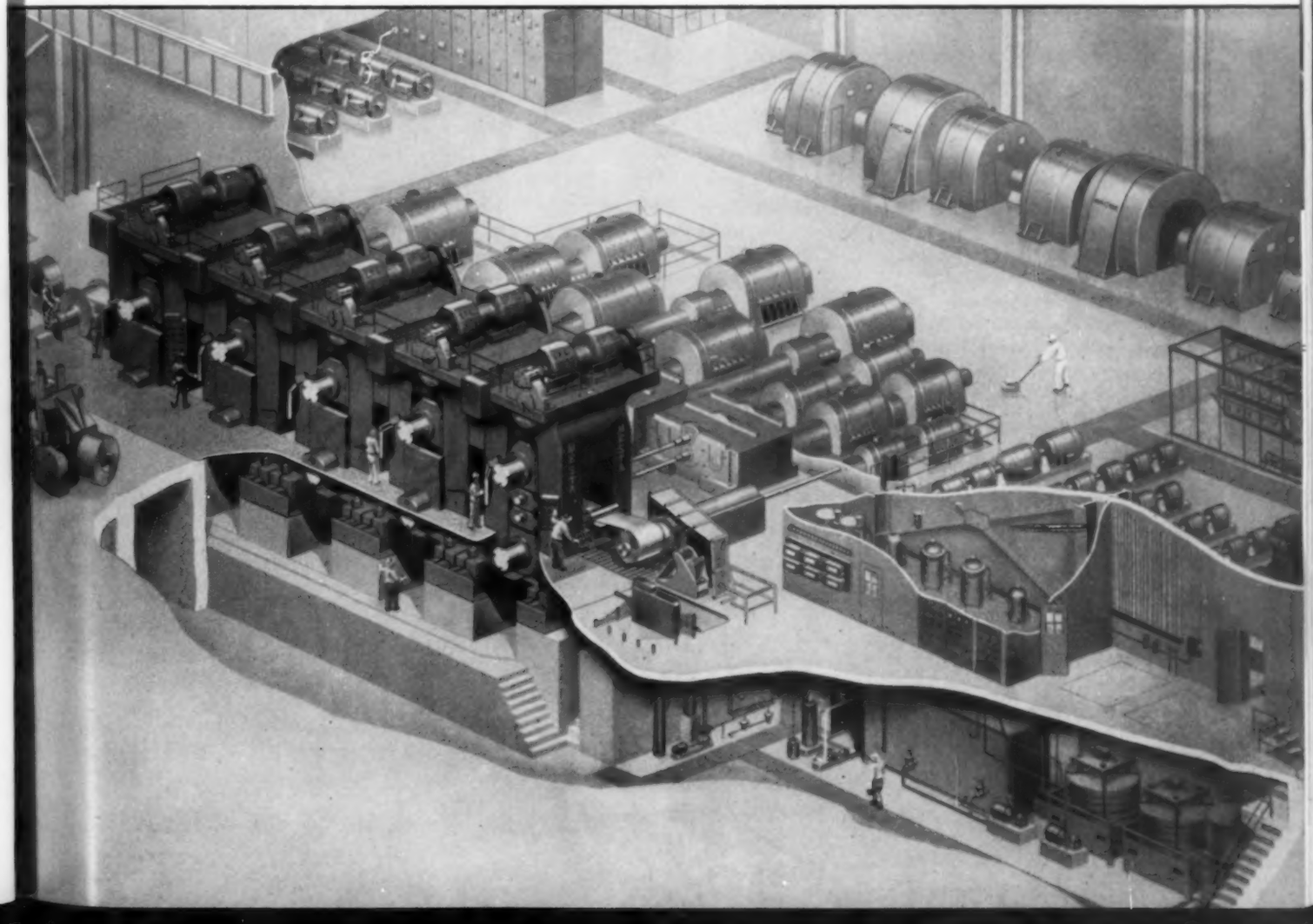
A number of new continuous pipe mills are now under construction. One new mill which is being built in the Chicago district will make pipe up to 4½ in. outside diameter and will be capable of producing from 120,000 to 150,000 net tons of product per year.

What constitutes a modern seamless tube mill will depend on the size ranges of the products. In a plant making small tubes up to 5 in., a combination of the rotary billet heating furnace, a combination cone-type Mannesmann piercing unit, a continuous rolling mill with an Assel mill as alternate, and a universal stretch-reducing and sizing mill with perhaps a cross-roll sizing mill for heavy walled tubes will constitute the mill setup. For tubes from 6 to 16 in. in outside diameter, a combination of a rotary furnace, cone-type Mannesmann piercer, a two-high plug rolling mill, two reeling machines and a series of two-roll sizing mill stands will be used. For pipe from 16 to 26 in. outside diameter, a modern combination consists of at least two large rotary heating units, two Mannesmann or cone-type piercing mills, a plug rolling unit, a rotary expanding mill, two reelers and a series of two-roll sizing units. From present indications, tubes will, in the future, be made much faster and piercing speeds will be increased. Inside surfaces will also be improved.

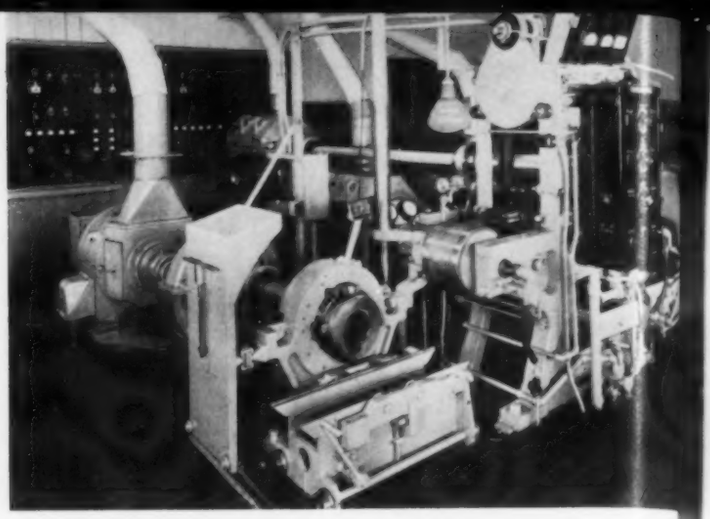
Recent experiments indicate that high alloy tubing will probably be made by extrusion. Carbon steel tubes can be extruded in sizes as small as 2 in. outside diameter with minimum wall thicknesses of 0.079 in. in lengths up to 50 ft, and stainless steel tubes can be made in diameters as small as 3 in. with minimum wall thicknesses of 0.117 in., in lengths up to 30 ft. Since the operating crew can be as small as 4 or 5 men, and the investment is less than that of the modern piercing mill, the process has potentialities, particularly when it is considered that alloys which cannot be pierced can be processed by this method.

A 4000-ton extrusion press which was used during the war for the production of rotating shell bands is now producing pipe in nickel, monel and other high nickel alloys in diameters up to 9¼ in. and in lengths up to 12

Cutaway sketch of 5-stand, 42 in. tandem cold strip mill shows mill proper, motor room and basement.



The finished coils of the 70-mphr mill have a 16 in. inside diameter and the outside diameter ranges up to 66 in. maximum. The finished coils weigh up to 30,000 lb.



A pilot 10 in. reversing cold strip mill, driven through the back-up rolls, was built during the year.

ft. These shapes can be cold drawn into seamless pipe 8 in. in diameter, and with wall thickness up to ¾ in.

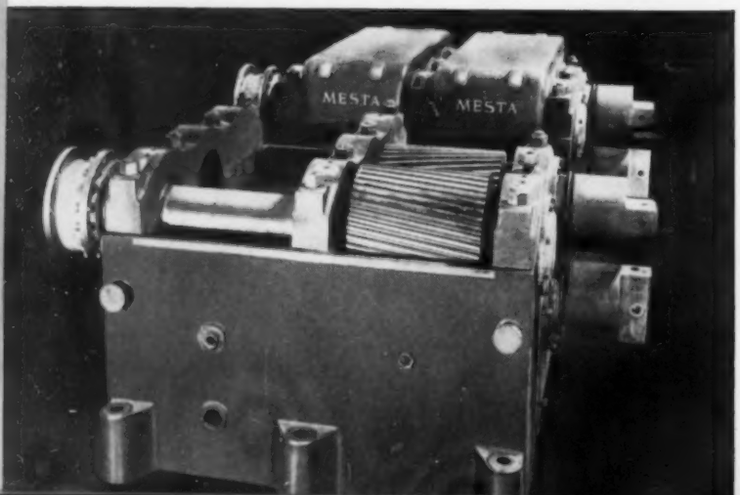
An innovation in welded tube mills is a twin-seam mill developed on the west coast. The first operation in this mill is to seam weld the edges of the strip, which is fed above and below the mandrel, with two resistance seam welders which are mounted face to face on wheeled carriages and operate along the track. The strip which is welded while flat is then moved over the mandrel by means of driving wheels and the mandrel forces the tube from a flattened oval to a true diameter in a distance of about 6 ft. A brass mandrel is used in order to cut down friction. This method makes possible wall thickness ratios of less than $\frac{1}{250}$ of the tube diameter in comparison with ratio of $\frac{1}{60}$ with the normal process. Tubing is processed from 20 to 24 gage strip at a rate of 50 fpm. Changeovers can be made from one diameter to another in about an hour.

A new style round straightener for bars and tubes was introduced during the year. This is a seven-roll machine which has clusters of three rolls at the entry and leaving ends of the machine, and a pressure roll in the middle. The rolls are mounted at an angle to the pass so that the stock rotates as it passes through the machine. The three-roll group confines the material to its exact pass line and there is no tendency for the stock to find a path of least resistance and thus evade the middle roll. No guides are necessary and the material comes in contact with rolling surface only.

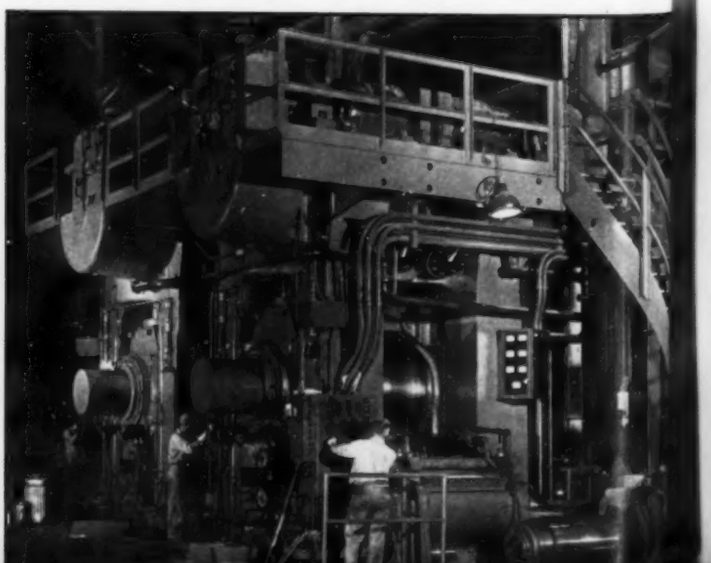
About 8 per cent of the steel made in this country is wire and more than half of this is used in the middle west. The large constant demand for wire products thus has resulted in many improved operating practices. In present practice, carbide dies have replaced steel and cast iron die plates almost completely, resulting in a three-fold increase in drawing speeds which are now more than 1500 fpm for ferrous materials. Present wire drawing practice use reductions up to 38 per cent on most carbon steel, and from 25 to 30 per cent on high carbon or spring wire. In drawing high carbon wire, water-cooled dies and blocks are used in order to dissipate the heat in the drawing operation. Such cooling is essential if the highest quality wire is to be finished at the indicated speeds, and particularly if close tolerances are required.

Because wet drawing of high carbon wire demands extreme care and rust-free material in order to obtain high production and in order to protect the dies, a compound of amorphous metaphosphate has been used to inhibit rust and lubricate the wire in process. It is

In a new 4-stand cold reduction mill which had twin motor drives, the work rolls of stands 3 and 4 are driven through a speed reducer and speed increaser respectively but the gear ratios were made the same in both cases thus enabling the use of duplicate equipment.



A new two-stand temper mill is driven by a 500-hp motor on No. 1 stand and an 800-hp motor on the No. 2 stand. Work rolls are 18 in. in diameter and back-up rolls are 49 in. in diameter. Machine finishing speed is 3000 fpm.



claimed that the use of this compound has allowed an increase of drawing speed up to 25 per cent. It has also produced a sharp reduction in damage to dies and wire. The amount of lime which is subsequently picked up is not as critical as in conventional practice.

A new flying shear was built during the year with a drive consisting of a single motor directly connected to the bottom knife of the flying shear. The knife is controlled by an adjustable voltage d-c generator driven by a synchronous motor, and a combination rotating regulator and electronic control. The shear can be accelerated to the proper speed in about ¾ of a second and can be stopped in the same period.

FINISHING

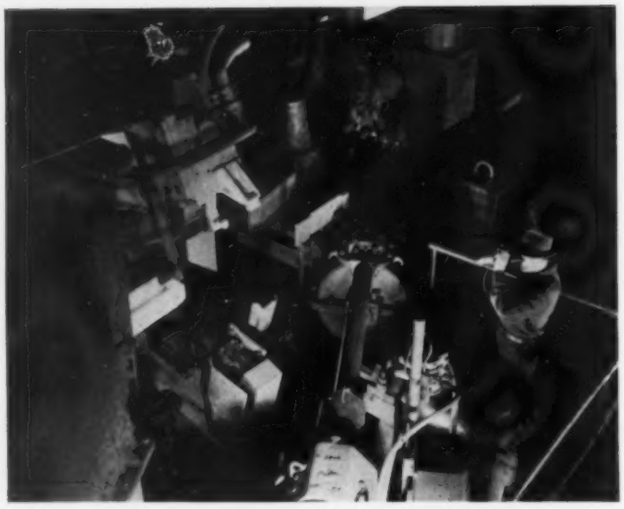
A new continuous galvanizing line, believed to be the first continuous line to use high frequency induction heating and to process continuously from the unannealed cold-reduced coil to the finished galvanized sheet has been announced. This line has been in operation for some time but details have been kept secret. Other similar lines are believed to be in use, although such lines have not been announced. The equipment coats strip from 20 to 54 in. wide and from 11 to 18 gage. In a 24 hour run, production will average 300 tons and the speed varies from 8 to 120 fpm. The units in the line consist of a leveler, automatic welder, electrolytic cleaner, looping pit, furnace, galvanizing pot, cooling tower, rinse tanks, bonderizer, looping pit, leveler and shear. In the furnace the sheet is first heated by induction heating and this is then followed by resistance heating. A hydrogen-nitrogen atmosphere is used for heating and cooling. It is reported that the coating is more uniform, there is some saving in zinc, and the operation takes much less time. At the same plant, a similar type line for light gage sheets is under construction.

Electrolytic tin plating of strip steel is being done at ever increasing rates and 38 in. wide strip has been plated with 0.03 mil of tin at a speed of 1000 fpm. A current density of 225 amps per sq ft in an alkaline stanate bath was used. Several electrolytic lines for the production of tin plate have reached maximum speeds of 1330 fpm and even higher speeds appear probable.

An effective method for continuous reflowing of tin uses gas radiant heaters for the heat source. The method gives heat at high rates for fast electrolytic tinning line speeds and the amount of heat can be easily controlled because of the inverse square law for radiation effect. The amount of heat can be easily and quickly controlled. A uniformly bright coating is obtained at economical costs. Another favorable factor is low space requirements.

An an attempt to reduce the heavy manual labor job inherent in the manufacturing of tin plate, a set-up has been installed in a plant in which lifts of sheared plate weighing up to 10,000 lb are delivered directly from the flying shears to the entry end of the tin stacks. These are then fed through a two-pass feeder into an electrolytic pickling tank consisting of a rubber lined tank equipped with two conductor roll assemblies in which the top roll of steel or carbon is paired with a bottom roll of rubber with glass micarta finger guides set between the conductor rolls. This automatic feeding and electrolytic pickling of sheets has eliminated the former white pickling operation as a process in tin manufacturing. A continuous line was also set up in tandem with a tin machine to inspect, count, weigh and package the material. The sheets go by conveyors to an inspection wheel where an inspector checks the sheet and by push button control sends them into three pilers, prime piler, mender piler and waste piler.

A new continuous pickle line was installed to serve the 70-mphr mill and on the left is shown the welding machine which welds into a continuous strip the hot rolled steel before it enters the pickle tanks. In the center the steel strip is shown coming out of the looping pit. Strip goes through four pickling tanks each 80 ft long. On the right the strip is emerging from the rinse tank from which it goes through a drying unit to eliminate wet patches on the strip before it is coiled.



The first fully automatic flame scarfing machine for removing surface defects from steel blooms was installed during 1948.

A new process of plating was developed in the past year which can be used for continuous plating of strip moving at fairly high speeds. Heat is the sole means for deposition in this new gas plating process. The process depends on thermal decomposition of metal carbonyls in an inert atmosphere of carbon dioxide. The object to be plated is heated by radiation in a plating chamber which is supplied by a metal carbonyl generator. A closed system is used which recycles the plating gases for operational economy. Carbonyls of a number of metals, including nickel, iron, chromium, tungsten and molybdenum, may be used in the process. Surface preparation is the same as for electrolytic plating. In a laboratory test operation using a small experimental unit, over 13 lb of nickel was deposited in a 60 minute single pass plating cycle. In another operation on continuous strip, an amount of metal which would have required thirty minutes to apply by conventional methods was deposited in four seconds.

A new method of plating wire has been developed which differs from normal procedures in that the desired plating metal is deposited on a heavy gage base wire by electrolysis in such a way that it will not separate from the base material and the wire is then further processed to the desired size and temper.

A unique feature of a new pickling line is the absence of the conventional dancer roll in the pickling tank. Replacing this roll, which has always required a great deal of maintenance, is a magnetic loop-position regulator which consists of a magnetic detector unit encased in an acid proof cover and located in the bottom of an acid filled tank. The output signal, which is governed by the position of the steel strip in the tank, is fed into a magnetic amplifier which in turn controls the speed of the entry pinch roll through a booster generator.

Some plants have found that steam jet agitators in pickle tanks give much faster and more economical pickling if the steam lines are installed so that the nozzles are set on about 15 in. centers. Practically every foot of the pickling line is thus heated and kept at the optimum temperature.

Investigation of the formation of scale has shown that the scale formed on low carbon steel at temperatures above 1065 F consists of three layers which from the outer surface in towards the center are Fe_2O_3, Fe_3O_4 and FeO. Because of these layers, some operators recommend that oxide conditioning of strip steel should be as follows: strip which is hot finished at 1500 F should be quenched on the runout table to 700 or 750 F before entering the coiler and this is specified for coils running from two to four tons whose heat-back upon coiling will elevate the temperature from 900 to 950 F. Following an air cool to 700 F, the coil should be water quenched and then they are ready for pickling.

A southern mill is using synthetic detergent which, when introduced in the pickling baths, reduces pickling time 30 per cent for hot rolled steel. The detergent has a wetting action which reduces drag out and improves pickling efficiency, while the foam on the bath surface blankets gassing and fuming.

Electrolytic polishing of stainless steels is developing at a rapid rate. The method produces a highly lustrous mirror bright finish. The operation is similar to electroplating except that current flow is reversed and the work is done on the anode. The process primarily supplements rather than replaces mechanical polishing. The equipment is simple, necessitating only a proces-

One of fourteen mechanical assorting, piling and reckoning lines installed this year in a West Coast mill for hot dip tin plate. The sheets proceed by conveyor to the inspection wheel where the operators inspect both sides as the wheel automatically turns over the sheet. By pressing a button the inspector can pass sheets to two piles for off-grade material or allow it to travel to the end of the line where prime plate is piled.

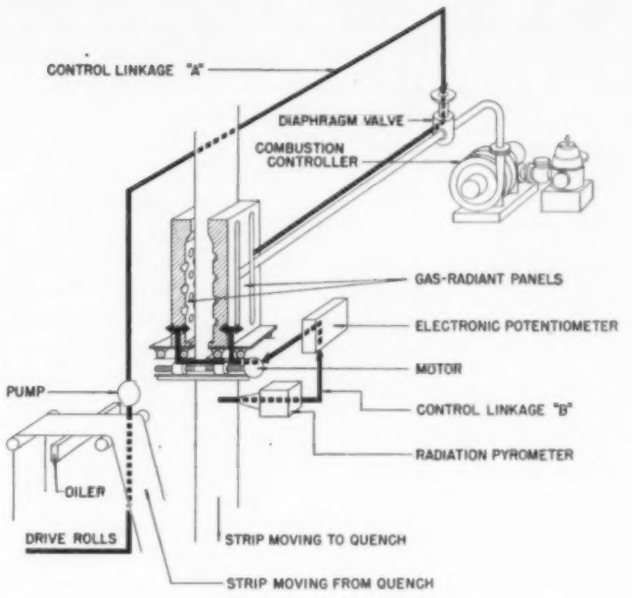
sing solution tank with a suitable arrangement of anodes and cathodes, a power source and rinse tanks. Current density runs from 0.5 to 1.5 amp at approximately 6 to 8 volts.

Molten salt baths are being used more and more for descaling. The fused salts change the scale chemically and thus its removal takes only from 0.1 to 0.01 of the usual pickling time. In one process, which has 38 units installed in 31 plants, the material to be pickled is dipped in a molten bath of a mixture of salts, and then passes through a water quench, acid quench and finally a rinse. Temperatures of from 900 to 1000 F are used and the baths are heated either by external gas firing, by immersion tubes or by immersion electrodes. The salts consist of a mixture of alkali, metal hydroxides, oxidizing agents and certain catalysts. The combination is such that they ordinarily regenerate themselves, for when the oxidizing agents have been reduced by the reaction with the scale they are reoxidized by the atmospheric oxygen at the surface of the bath. The process is very versatile and can be used on chrome-nickel and straight chrome stainless, stainless clad, and carbon steels, as well as on nickel and many types of alloys.

The sodium hydride process is similar to that described in the previous paragraph, but operates at a lower temperature (700 F) and the chemical reaction is better understood. Several sodium hydroxide descaling plants went into operation, and were found particularly effective in removing the metallic oxide scale on stainless and clad metals. Briefly, the process consists of immersing the material to be descaled in a molten caustic bath which has been impregnated with sodium hydride, the caustic bath provides the wetting action and carrying body for the sodium hydroxide which has a great affinity for the oxide scale. The stainless material is then dipped into a water quench tank where the reaction blasts the scale free. This is then followed by a dip into 10 per cent sulphuric acid for neutralization of the caustic and then by a dip into a nitric-hydrofluoric acid bath for brightening, after which the material is cleaned with water.

Shot blast cleaning is also finding additional applications. Although it cannot eliminate acid pickling, it can be used efficiently when the coating to be removed is hard and dry, and in the steel plant its particular application is for cleaning preliminary to electro-plating, galvanizing, hot dipped coating and metallizing. The cleaning must be done with a fine grit. Another application is for cleaning strip or sheet before cold rolling, although in this case it is sometimes desirable to follow up with a brief 20 to 30 second pickle to remove iron dust. The blast cleaning unit can be adapted to either batch or continuous operation. It has the advantages of no waste disposal problem, and requires less floor space. There is no danger of hydrogen embrittlement, and there is no appreciable metal loss in proper operation.

The disposal of waste pickle liquors is receiving considerable attention. Because of the increasing scarcity of high-calcium lime to be used as an acid neutralizer attempts are being made to find substitutes, and readily available dolomitic limes have been found to be adequate, although they have lower reaction rates with acids. The basicity advantage places the two agents on a relatively equal basis.



Extremely rapid temperature control is available for reflowing of tin by the gas radiant method. Two control systems are actually used, "A" has the function of throttling fuel input to the heating panels in proportion to the line speed. Control system "B" has the function of moving the radiant panels to and from the passing strip. These movements are made in direct response to strip temperature as it is measured by radiation pyrometer.

In a series of studies on absorption methods for handling waste pickle liquor at the University of New Hampshire, the best selective absorption for ferrous sulphate, in neutral and acid solutions, requires use of activated charcoal. Ninety per cent of the ferrous sulphate in neutral and acid solution was found to be absorbed by the equivalent of activated charcoal.

FUELS AND FURNACES

One important factor influencing combustion is the ever changing fuel picture. From a long range point of view, because of the ever increasing demands for petroleum as well as the continually rising cost of locating and producing crude oil, it is believed that the price of petroleum will establish itself at such a level that the deliberate diversion of crude oil to fuel will be uneconomical. It will then become necessary for other fuels, and coal in particular, to assume an increasing proportion of the industrial fuel load.

Since liquid fuel can be produced synthetically from such raw materials as coal and natural gas, these processes will undoubtedly come into production as crude oil becomes sufficiently scarce. Various methods for doing this are being tried at the present time. It is more costly to synthesize liquid fuel from coal than from gas, but because of the greater reserves of coal, this method will in the future probably be the most important. About 6500 tons of coal with a Btu content of 12,000 to 13,000 per lb are required to produce 10,000 barrels of petroleum.

Although the western hemisphere at the present time

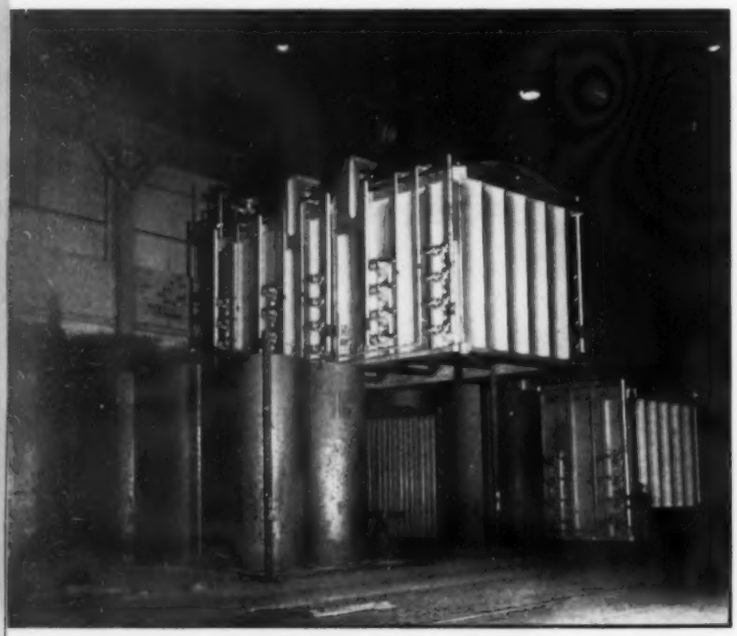
has a surplus of oil production, it is estimated that by 1951-52 it will be necessary to import oil to meet our overall requirements. Importation is by far the cheaper method of getting additional fuels on present cost basis, but in time of war may not be a sure source of supply.

Secretary of Interior Krug has been pushing a program which would set up a synthetic fuels industry. He reports that the oil-shale demonstration plant at Rifle, Colo., indicates that crude shale oil can be obtained at $2.00 and $2.50 per bbl. He also estimates that the coal oil plant at Louisiana, Mo., can make high grade motor gasoline commercially for about 14 cents a gal which is about double the present cost. In the steel industry the shortage in oil has resulted in a trend since the end of the war from oil to coal or to fuels produced from coal. Blast furnace gas is being used to underfire coke oven batteries and in soaking pits. The coke oven gas thus liberated is being used in open hearth furnaces up to about a 50 per cent of the total heat input without a loss in steel production. Boilers are being fired with powdered coal or with coke breeze to replace blast furnace gas. If fuel oil is to be ultimately replaced entirely by coal, the next step would be to increase the use of coke oven gas in the open hearth, supplementing this with manufactured gas up to about 70 per cent of the total open hearth requirements, and filling out by 30 per cent firing of tar or pitch for luminosity and flame radiation requirements.

Two basic processes for converting coal to oil are under study at the new Bruceton laboratory of the Bureau of Mines. One is the gas synthesis or indirect Fischer-Tropsch process and the other is a direct hydrogenation of coal or Bergius process. These processes are complementary rather than competitive, for the products which each process will best produce differ.

The Bureau of Mines also authorized a $4,413,250 gas synthesis Fischer-Tropsch process demonstration plant near Louisiana, Mo., to produce oil from coal. This is the third of the demonstration or semi-commercial scale plants planned under the synthetic liquid fuels research and development program of the Bureau. This plant will have a capacity of 80 bbls of oil and gasoline a day and will include a coal gasification unit. The plant is adjacent to the Bureau's hydrogenation (Bergius process) demonstration plant also near Louisiana, Mo.

Typical of the cover type annealing furnaces being installed is this one designated to hold 8 stacks of cold reduced coils.



Because of the seasonal shortages in natural gas, several plants have set up standby systems for supplying fuel. A number of expedients have been used which include accessory oil burning equipment, petroleum gas, auxiliary systems and auxiliary gas producing plants. One such gas generator which has been developed uses gasoline. This gasifier consists of two castings assembled together to form a combustion chamber with spark plug ignition. Fuel is admitted through a valve which provides control of the gas generation. The unit is about 6 in. high, 4 in. long and 3 in. wide, and has no moving parts. Its capacity varies from a minimum of almost 0 to a maximum of 1,500,000 Btu per hour. The advantages of this installation are the small space requirement, low cost and instant availability.

Further work on the unmined coal gasification which was reported last year continued in Alabama. The experiment is being carried out in similar coal seams 100 to 125 ft down. Higher air pressures are being used, and it is expected that the Btu content of the gas will be increased from the 50 obtained last year to 150 in the new experiment.

The demand for natural gas reached new peaks during the year, principally because its cost went down in comparison with other fuels. Fortunately the reserves during 1947 increased by more than five trillion cu ft and total reserves at the beginning of 1948 were nearly one hundred sixty-six trillion ft. As a result, there has been a very heavy program of pipe line construction in order to transmit this gas to the industrial east.

During the year the first catalytic cracking plant to attain full commercial production for a utility began delivering gas to the distribution mains of the Long Island Lighting Co. This unit was installed to meet winter peak loads, and offers possibilities for many industries. The plant is flexible in operation and compact in size. The principal item of equipment is the catalytic cracking furnace which breaks down the hydrogen-carbon vapor into a fixed gas. At the Long Island installation, gas of 240 Btu is obtained. This then is enriched to 540 Btu. The base feed stock is propane; gasoline and casing head products can be used.

A new rotary heating furnace at a pipe mill in the Chicago area is the only one of its kind which has five separate heating zones. The circular kiln has an outside diameter of 61 ft and an inside radius of 19 ft. Temperature in each heating zone can be controlled independently of the others. The facilities are particularly adapted to the production of tubing.

A roller-hearth furnace is accomplishing in one operation what previously required seven. Up to now, pickling was the only method known for treating and preparing metal surfaces for porcelain enameling. This furnace turns out a product surface which is not only equal to that obtained by pickling, but in some ways is superior.

These slag pots in a southern mill are being dumped by means of compressed air instead of by steam as used to be normal practice. Since this train is run by a diesel locomotive a special car is attached to the locomotive which compresses air for operation of the slag pots.

MATERIALS HANDLING

Conveyors, lift trucks, cranes and other special devices are being used to an ever-increasing degree in steel plant operations. The heavier and larger coils and other items required for operational economies and high speed production need much such equipment. In selecting such equipment, the question of economical size coils is a difficult one to analyze. For efficient mill operation, it is most desirable to run as large a unit as possible, but the resultant coil sizes are in turn limited, however, by the materials handling equipment. The industry wants to use heavier coils, even up to 60,000 or 75,000 lb. Whether cranes, conveyors or truck should be used is dependent on the local layout, allowable floor loads, and operational plan.

What is thought to be the heaviest pallet-type conveyor system ever built for coils was installed in connection with the new 70 miles-per-hour strip mill in the Pittsburgh district, moving coils from pickling lines to coil storage and feeding the mill. Industrial trucks are used for the intervening move.

The new 5-stand cold strip mill at Weirton features an unusual overhead coil conveyor. In this installation the coils coming from the 60 in. pickler are lowered by a turndown onto a short roller table and moved to the charge end of the overhead conveyor which takes them to the tandem mill. Each coil has its own individual car. The use of the overhead conveyor saves space.

Chain conveyors, in lengths of 1000 ft or more, are now designed for hot mill coils whose weights run up to 30,000 lb. Since coils for cold mills are increasing in weight, it has been recommended that they be handled by a troughed roller conveyor which will operate by a single chain equipped with knockover pusher dogs, with final travel on a feeder conveyor of the platform or pallet type.

One of the biggest changes in materials handling in the open-cut ore mines in the Superior district has been the use of the belt conveyors to handle the iron ore. It has proved cheaper and more efficient than the rail-haulage system previously used.

Two enormous cranes operating on one runway were installed during the year for the Navy at Hunters Point, San Francisco. These are the largest in the world. The cranes have a 142 feet span and the girders are 22 feet deep. These two cranes can work together through a lifting beam to form the world's largest crane, lifting loads up to 630 tons. The cranes are arranged so that they can be coupled together electrically as well as by means of standard car couplings so that they can be moved along the runway as one unit.

An item which will save time in materials handling, as well as making better records available, is a weighing device which can be attached to a crane hook. It is claimed that loading time can be reduced as much as ⅔, and weights can be determined in spots not now practical.

Thirteen new mixer-type hot metal cars were installed during the year at one steel plant. These cars which were built to carry 200 tons of molten iron ore are the largest used in the steel industry. They operate on a short haul between the blast furnaces and bessemer converters.

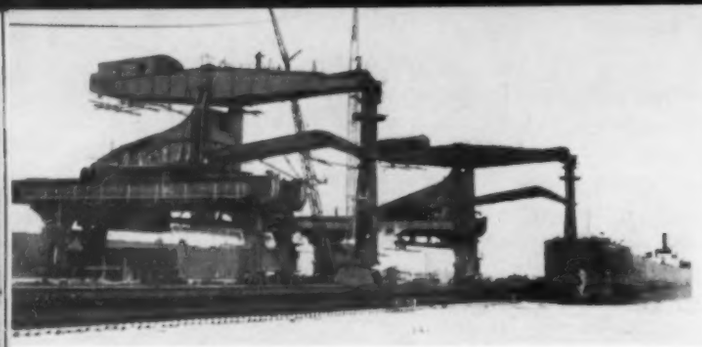
The diesel engine is finding increasing favor in steel plant operation, and the steam locomotive is apparently on the way out. As a matter of fact, one of the largest manufacturers of locomotives discontinued the production of steam locomotives in the past year. On the other hand, there is development work underway on steam locomotives. The geared turbine locomotive will probably find its place in railroad operations, although not in the steel plant. Other work being done at the present time is the development of better boilers to reduce steam consumption and it now appears possible that steam consumption per horsepower hour may be cut 30 per cent with fuel reductions of 50 per cent. The gas turbine is also being developed for railroad use, but it also is apparently best for regular railroad service.

A new ore and coal dock was completed at Toledo, Ohio in the past year which will expedite the handling of coal and ore at this port. Among the unusual features is a coal dumping device which is electrically operated and which can dump loaded coal cars at the rate of one a minute. These docks are served by two ore unloading machines, each of which can unload ore at the rate of 30 tons per minute and there are three coal dumping machines.

The problem of unloading frozen coal is solved by an electric vibrating unit that is used to empty frozen coal at a steel plant. This unit, which sets up harmonic vibrations of over 1000 impulses per minute, will complete the coal-loosening operation in two to five minutes compared to the 15 to 60 minutes if manual labor is used.

MECHANICAL DEVELOPMENTS

The first gas turbine to be bought by an electric utility was purchased during 1948. It is a 3500-kw turbine generator, and will be operated on natural gas which is available on the site. The unit has an in-line arrangement of compressor and combustion chambers, and will be geared to a conventional 3600-rpm, totally enclosed generator. The only water required for operation will be a small quantity for cooling the bearing lubricating oil and for cooling the a-c generator. Two 5000-kw, high efficiency gas turbine power plants were also ordered



Two huge ore unloading machines serve the new coal and ore dock at Toledo, Ohio.

during the year. They will utilize intercooling and regenerative heat-transfer surfaces to recover waste heat. Proposals are now being considered for gas turbines for units of 20,000-kw full load capacity and 1100 F turbine inlet temperature.

Several power plants completed during the year reached a new top steam temperature of 1050 F. At one plant this is being used in a 100,000-kw turbogenerator, and another unit using this temperature is a three-casing 150,000-kw cross compound machine. These units are in utility stations. At these temperatures every 50 degrees rise decreases the amount of coal required by about 1.4 per cent. This new turbine produces 2500-kwhr for each ton of coal burned. With this new peak in temperatures, the recent trend away from reheat cycles is being reversed, and some of the newer units are being designed for reheat.

One turbine manufacturer is making the larger stationary, low pressure blades hollow, which results in worthwhile economy of material since they are made of stainless.

The first post-war mercury unit power plant went into operation in New England as a topping plant, producing 15,000 kw from the mercury turbine generator. It also provides some 200,000 pounds of steam at 400 psi pressure to drive existing steam turbines.

There has been a definite increase in the development of packaged boiler units in the small sizes. These are produced with all accessory equipment ready to be placed on the job and connected.

One item developed during the year which will be useful in maintenance of power plants is a portable electronic instrument which, when pushed through a tube, will chart the condition of the metal and locate such defects as pinholes and scale. The instrument is now available for spotting defects in non-magnetic tubes.

A new use for television is creeping into the industry. At one power generating station, a television set is used to read gages which are located at the top of the boilers.

The power plant of the future may be a basic processing center. An installation may consist of coal being burned underground, forming a gas product which in turn may be synthesized into liquid fuels and by-products. Gas and steam turbines may in turn then generate power which will be transmitted by power line. The gas produced may in turn also be transmitted by pipe line. Thus, the materials handling cost of coal may be completely eliminated. From present indications power plants, based on atomic energy, are apparently far from practical realization.

A new process for the manufacture of relatively pure oxygen in tonnage quantities was announced during the year. Pilot plant operations have demonstrated that the process can operate without the necessity of periodic "defrosting" shutdowns. In this process, preconditioned air is cooled to below —300 F and distilled in a distillation column into its components, oxygen and nitrogen. The oxygen is then piped to its place of use. The nitrogen is pure enough to be used as a chemical raw material or for bright annealing in steel mills. It is estimated that plants can be built which will produce more than 25,000,000 cu ft (1000 tons) of oxygen per day. The heart of the process (which is low pressure system) is a turbo-expander which is essentially a small, high-speed, radial flow turbine, whose principal function is to produce refrigeration at the low temperature levels required for the distillation of air into its components. Useful power is developed as a by-product. The pilot plant produces 95 per cent pure oxygen. It is claimed that the system is completely immune to dangers of acetylene explosions, and will operate at reduced loads without sacrifice of efficiency. The system is mechanically simple and all controls are automatic. Oxygen can also be made as pure as 99.5 per cent. Maximum pressure is about 5 psi.

A recent welding development uses an inert gas, argon, for spot welding. The weld is produced from an electric arc applied to the top surface of two lapped pieces of metal. One unusual feature is that the welding can be done entirely from one side, and access to the other side is not necessary.

Of particular interest to strip mill operators is a welding machine that heats the ends of hot rolled strip steel to a plastic state and then forges them together with an upsetting impact having a pressure up to 12,000 psi. The welding time is about 10 seconds and the resultant weld can be cold reduced with the rest of the strip. The mechanical operations of the welder are hydraulically actuated, and electronic controls limit the current during the welding cycle. The flash from the weld is shaved off in a special trimmer.

Another new welding method developed during the year is cold pressure welding. This method at present is best adapted to aluminum and copper, although other meals can be cold-welded. There are two important items in this process. One is preparation of the surface and it is essential that the two surfaces which are brought into contact be entirely uncontaminated. The second requirement is that the pressure be applied over a comparatively narrow strip so that the metal can flow away from the weld at both sides. This is achieved by applying the pressure between specially designed dies. Pressures required are in the region of between 24,000 and 36,000 psi for aluminum, and for copper they should be three or four times these values. These pressures should be sufficient to set up plastic flow of the materials to be welded.

The new strip mills have some unusual lubrication features. One of the most recent installations has a special recirculating oil system for the back-up rolls, with a similar system for the drives and screwdowns. Another system handles the palm oil. Two 14,000 gallon tanks are used in the system for the back-up bearings, and contain steam coils to maintain a temperature of 110 F. The system for the pinions is similar, with the extra pressure oil kept in a 8000 gallon tank and circul-

ated by 200 gpm pumps. Grease pumps supply extreme pressure lubricant to the work roll bearings at definite time intervals and in definite amounts. The palm oil and water are mixed in a tank and pumped to the roll by 42 pumps. The palm oil is then recovered for reuse. One unusual feature is the automatic fire control apparatus which is installed in the oil cellar. This system will flood the entire area with two tons of carbon dioxide for a period of two minutes.

On November 18, delegates from the United States, United Kingdom, and Canada signed an agreement on unification of the American and British standard systems of screw threads. The present unification agreement uses a 60 degree angle and a rounded root for screw threads. The crest of the external thread may be flat, as preferred in American practice, or rounded as preferred by the British. The number of threads per inch for the various series has been standardized and the limiting dimensions for three grades of thread have been agreed upon. Thus, interchangeability of screw thread parts now becomes feasible.

The old British or Whitworth system was based on a thread angle of 55 degrees with a thread form having round crests and roots. The American Sellers System had a thread angle of 60 degrees with a thread form having flat crests and roots. There is little change in the number of threads per inch but a new ½ in. coarse thread has been added which has 12 threads per in. in addition to the one which has 13 threads per in.

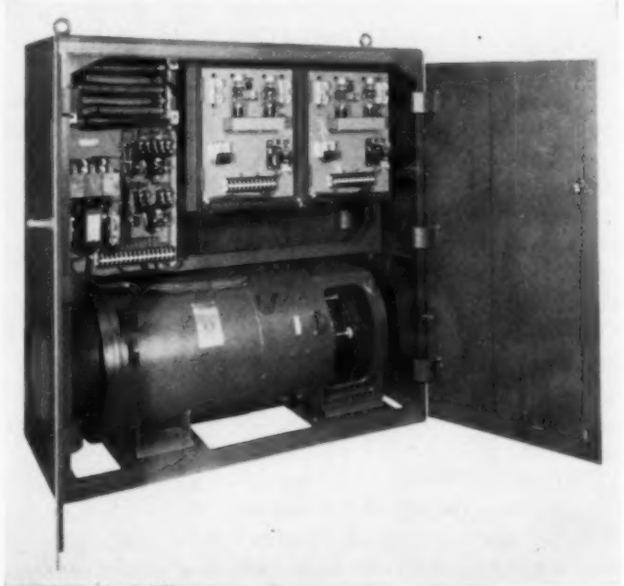
The open hearth fume problem, which has been particularly troublesome with oxygen, was substantially overcome in one plant by the use of a scrubbing device for cleaning stack gases. The unit is a venturi scrubber and it is said to be 95 to 99 per cent efficient in iron oxide fume removal. The fume is highly magnetic and has a mean particle size ranging between 0.115 and 0.183 microns. The method consists basically of a means of injecting low velocity liquid into a high velocity stream of dirty gas. The gas impinges upon and disrupts the liquid, and much of the liquid is finely atomized. The mixture of gas and spray is then decelerated and separated, at which time the liquid contains most of the solids.

In maintenance work, chrome plating of worn parts has been found to increase the wear resistance appreciably and is being used in a number of steel mill applications.

Carbide roll roughing and finishing tools have been developed which decrease markedly the time required in turning and refinishing hard rolls. A number of special shapes are used to expedite the different operations.

Tests during the year have proved that it is practical to inspect heavy steel billets with the betatron to determine the exact depth of the end shrinkage flaw or "pipe." Thus, the machine may be used so as to eliminate wasteful remelting of thousands of tons of steel. A 10,000,000-volt betatron was installed during the year at the Naval Laboratory. It can X-ray rolled steel 10 in. thick at a distance of six ft. in 30 minutes. This is eight times the speed obtained with 2,000,000 volt equipment.

The short stroke dancer roll control system is essentially a phase shift rectifier which is capable of producing a variable rectified d-c output voltage.



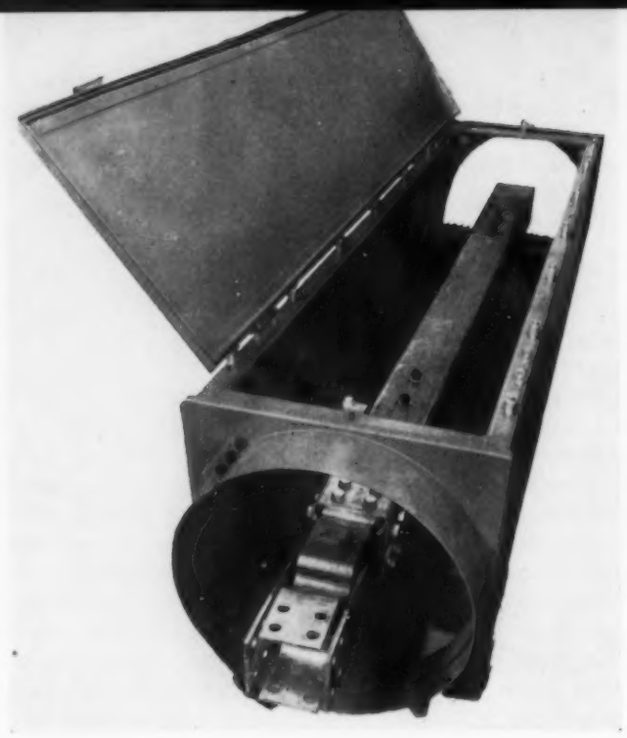
ELECTRICAL DEVELOPMENTS

The figures for power consumption released in 1948 for the year 1947 showed that the nation's steel industry used a total of 23,000,000,000 kwhr of electricity, averaging 275 kwhr for each ton of steel, and it is believed that this consumption will increase. As one example of the increased power which will probably be required by the steel industry, it has been estimated that the beneficiation of low grade ores may require as much as 70 kwhr per ton of ore, compared with the present average of 4.5 kwhr. One of the largest single power consumers in the country is the arc furnace. The present installed capacity is about 3,000,000 kw and this figure is growing rapidly.

The most outstanding engineering developments and trends in the electrical industry for 1948 were those in the field of power production. Public utility companies are expected to spend about $16,000,000,000 for new and improved generating and distribution facilities within the next ten years. Thus, production of electric power in this country will be increased from slightly over 282,000,000,000 in 1948 by the utility companies to 430,000,000,000 kwhr with an increasing expansion of generating capacity in this coutry from 56,000,000 at the end of 1948 to over 95,000,000 kw. In addition industrial plants generated 54,000,000,000 kwhr for their own use.

The electric manufacturers have standardized on six preferred ratings for large 3600 rpm condensing turbogenerator units. These ratings are 11,500, 15,000, 20,000, 30,000, 40,000, and 60,000 kw. The two larger sizes are available for steam conditions of either 850 psi at 900 F or 1250 psi at 950 F. About 85 per cent of the turbogenerator units being ordered are designed to operate at 3600 rpm and about 93 per cent are hydrogen-cooled.

Most of the tandem cold reducing strip mills now being built are arranged so that each of the mill drive motors is fed from a separate generator. Although this system requires more complex regulating control than the high current booster generator, they afford greater flexibility in making up rolling schedules as the motor



This metal enclosed bus can carry 15 kv, 4000 amperes.

speed ranges may be extended by operating some of them at reduced voltage.

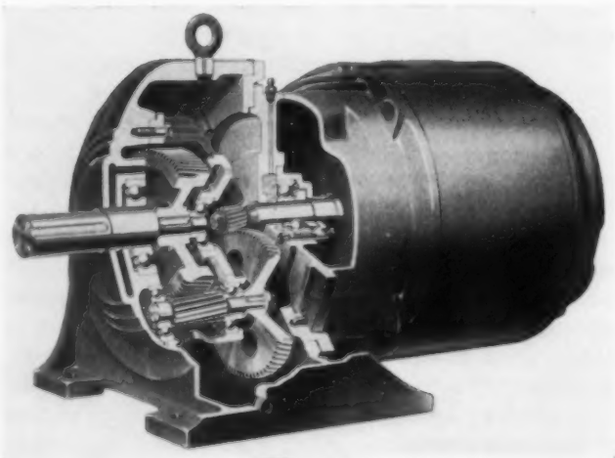
One of the fastest existing electric-tinning lines has been given a greater capacity by the addition of 300 kw of 9600-cycle induction heating for flow-brightening.

To measure roll screwdown setting accurately, a large Southern mill is applying a d-c positioner as a differential 20-in. dial indicator. The system operates from the d-c supply driving the screwdown motors, thus preventing the indicator from getting out of step in the event of a power interruption.

The use of X-ray thickness gages has been found to increase sheet output of prime sheets. There is no contact with the material. Several of the new tinplate mills have been equipped with these gages.

Mercury arc rectifiers are being given serious consideration as a power supply for hot strip finishing mill motors. A hot strip mill is now being built for France whose six finishing stand motors with a total of 23,000 hp will be supplied by three 5000-kw rectifiers. On a mill to be modified at a West Coast plant, rectifiers alone will be used for full adjustable voltage control of a continuous hot strip mill. Two mercury arc rectifiers, each rated 4000-kw, 600-volt (5000 kw with transformer fans), will supply power to the finishing train motors. These rectifiers will be used to start the mill motors from rest by phase retard. The output of each rectifier will be regulated by either a new magnetic amplifier or amplystats.

Illustrated here is a new gear motor which went into production in the past year.



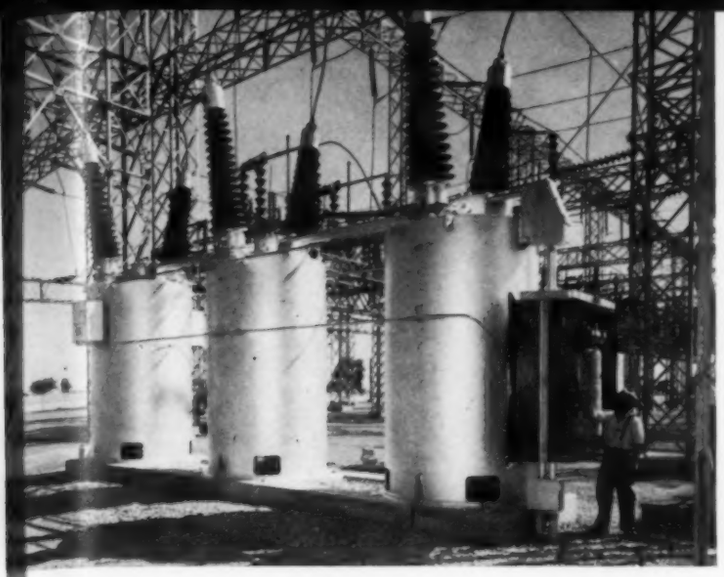
One of the largest pump-evacuated frequency changing installations in the country will operate in a midwestern steel mill with the re-rating to 8000 kw of a 6667 kw, 25/60 cycle mercury arc system installed in 1942.

A new rod mill installed in a middle west steel plant has a number of unusual features. This mill delivers two rods simultaneously from 19 stands set in tandem. Rod sizes range from No. 5 to ¾ of an inch and are made from hot billets up to 2½ in. square and 40 ft in length. Nine d-c motors with total of 3900 hp and three 1000-kw generators provide a flexible driving arrangement. Since the stands in this mill were placed much more closer together than is the usual practice, more accurate speed regulation was required. Fly wheel effect was added to the motors and instantaneous speed regulation is nearly obtained by quick acting-rotating regulators. The overall speed of the mill is set by a reference bus under the control of a master pilot generator. Each driving motor is equipped with a pilot generator and any change in motor speed is transmitted to the electronic amplifier. The signal is passed along at a higher voltage to a rotating regulator booster which then changes the motor speed by the right amount. The electronic regulator is designed for a sensitivity of linear response of plus or minus 0.2 of a volt with an available amplification of 450 to 500. Three motors in the stands have the same arrangement except that speed correction is obtained by a direct-acting rotating regulator in the shunt field circuit.

The magnetic amplifier has developed from a laboratory device to actual use in the steel plant. It is a static amplifier and is based on the principle of a d-c saturable reactor where a small input signal can be used to control a relatively large output signal. It will undoubtedly take the place of rotating regulators or electronic amplifiers in many regulating circuits and will undoubtedly be applied in conjunction with the rotating regulator in many others.

Variable voltage drives have been applied to continuous strip pickling lines to provide smoother control and higher speed. The entry end and the delivery end are operated on separate systems so that the delivery end may operate practically continuously, slowing down or stopping only briefly to shear the strip and discharge the completed large coils. The entry end, on the other hand, operates intermittently starting new raw coils, shearing the ends square, and joining the ends by flash welding. One pickling line now in operation is designed for 700 fpm maximum strip speed through the pickling tanks, with an entry end speed of 1400 fpm maximum.

Three of the world's highest rated kva transformers were constructed during the year. They are not the largest in size because of the corosil steel used for magnetic cores and the forced-directed flow of the cooling



These oil circuit breakers have a capacity of 230 kv and are installed on the lines of a western utility company.

liquid. The voltage range is from 15,000 to 135,000, and each are rated three-phase, 145,000 kva.

A new line of low voltage (600 v) current transformers was developed during the year. It is claimed that this new transformer can maintain accuracy at 60 per cent overload without overheating.

Switchgear developments during the year emphasized completely co-ordinated factory-built equipments. There was also a large increase in the interrupting ratings of commercial voltage power circuit breakers. Nine factory-built 230-kv switchgear units were designed with an interrupting rating of 10,000,000 kva without increase in the physical size of the breakers. The highest rating previously available was 3,500,000 kva. These units will control the output of the nine 108,000 kv generators in the north power house of Grand Coulee power projects. The increase in rating was accomplished by using the multiflow deionization grid principle developed for high voltage.

A new line of high current contactors, rated at 1500, 3,000, and 6,000 amp at 750 volts, was developed primarily for mill applications.

Several new high-pressure gas-filled cables of the pipe type and mass-impregnated construction were installed for high voltage during the year.

A new gearmotor was introduced last year which has an unusually compact design. These motors are built in six basic sizes capable of delivering 1 to 60 hp. These are helical type, horizontal units and are completely integral a-c or d-c motors with flange mounting and operate from 7½ to 780 rpm. Single, double, and triple reduction units are available in each size.

Clamp type linings were introduced during the year for use on magnetic brakes for mill and heavy duty service. The construction gives a brake lining which is smooth, has a large braking area, gives longer wear, and can be changed without removing the shoe from the brake.

A new device developed during the year provides a simple way of measuring extremely heavy direct currents. Instead of the usual large shunt, a special current transformer of the through type is used whose secondary winding is energized by alternating current at some convenient low potential. A change in the direct current affects the reluctance of the magnetic circuit and in turn the current flowing in its a-c circuit. This a-c current is then measured on the conventional ammeter calibrated in terms of the d-c current in the heavy bus. The scheme is accurate to ½ per cent.

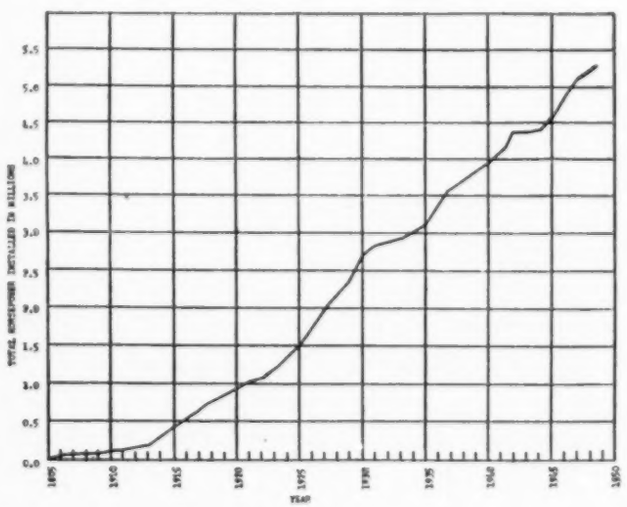
Magnetic suspension of the moving element is the outstanding feature of a single-phase watthour meter introduced during the year. A cunico magnet is attached to the frame and another is an integral part of the disk-and-shaft assembly. Interaction of the two magnetic fields supports the moving systems in a state of equilibrium. The new meter has longer life, improved performance, and lowered maintenance cost.

One of the interesting electrical developments has been the application of printed electrical circuits. Printed components such as capacitors and resistors are available which reduce equipment costs very markedly. So far the development has been applied primarily for circuits for communication work and low loss, and high-stability capacitors. The process is based on laying down by spraying layers of vitreous enamel, alternating with layers of conductive silver paste deposited by silk screen or squeegee printing. The ceramic dielectric has a loss factor of the same order as mica. The properties of silver are such that high electrical conductivity is obtained. The units can be made very small.

Interest has been aroused in this country in the nickel-cadmium batteries, using an alkaline bath. This battery has been used for a long time in Europe but has only recently been introduced in this country. It is claimed that they will last three times longer than present type batteries.

One interesting X-ray machine developed during the year was a super-speed motion picture camera. This equipment takes X-ray exposures of 10 millionths of a second, using a shutterless camera shooting movies at 100 frames a second. The machine offers vast possibilities for the research worker in studying and observing physical phenomena.

The cumulative curve of main drive motors over 300 hp shows a total to January 1, 1949 of 5,266,090 hp. One hundred four motors (137,800 hp) were added in 1948.



ELECTRIC MOTORS OVER THREE HUNDRED HORSEPOWER

APPLIED TO MAIN ROLL DRIVES IN THE IRON AND STEEL AND ALLIED INDUSTRIES DURING 1948

Item	Horsepower	Revolutions per minute	Volts	Frequency	Method of drive	Type of mill	Purchaser	Location	Manufacturer
1	300①	400/600	600	d-c	Direct	Stand No. 1 of 2-stand temper mill	Weirton Steel Co.	Weirton, W. Va.	General Electric
2	300①	400/600	600	d-c	Direct	Stand No. 1 of 2-stand temper mill	Weirton Steel Co.	Weirton, W. Va.	General Electric
3	300	300/600	230	d-c	Geared	42 in. Reversing hot strip mill reel	McLouth Steel Corp.	Detroit, Mich.	Westinghouse
4	300	300/600	230	d-c	Geared	42 in. Reversing hot strip mill reel	McLouth Steel Corp.	Detroit, Mich.	Westinghouse
5	300	225/775	600	d-c	Direct	66 in. Temper pass mill reel	Columbia Steel Co.	Torrance, Calif.	Westinghouse
6	350	500/1000	250	d-c	Geared	48 in. Skin pass mill tension roll	A. C. E. C.	Belgium	Westinghouse
7	400	250/960	325	d-c	Geared	Skin pass mill	Granite City Steel Co.	Granite City, Ill.	Allis-Chalmers
8	400①	575/750	600	d-c	Direct	2-Stand temper mill delivery puller	Weirton Steel Co.	Weirton, W. Va.	General Electric
9	400①	575/750	600	d-c	Direct	2-Stand temper mill delivery puller	Weirton Steel Co.	Weirton, W Va.	General Electric
10	400	250/1200	600	d-c	Direct	2-Stand temper mill winding reel	Weirton Steel Co.	Weirton, W. Va.	General Electric
11	400②	575/1150	600	d-c	Direct	Temper mill entry puller	Inland Steel Co.	East Chicago, Ind.	General Electric
12	400①②	575/1150	600	d-c	Direct	No. 2 Stand of 2-stand temper mill	Inland Steel Co.	East Chicago, Ind.	General Electric
13	400①②	575/1150	600	d-c	Direct	No. 2 Stand of 2-stand temper mill	Inland Steel Co.	East Chicago, Ind.	General Electric
14	400①②	575/1150	600	d-c	Direct	Temper mill delivery puller	Inland Steel Co.	East Chicago, Ind.	General Electric
15	400①②	575/1150	600	d-c	Direct	Temper mill delivery puller	Inland Steel Co.	East Chicago, Ind.	General Electric
16	400	300/900	600	d-c	Geared	48 in. Reversing cold brass mill reel	Direccion General de Fabricaciones	Argentina	Westinghouse
17	400	300/900	600	d-c	Geared	48 in. Reversing cold brass mill reel	Direccion General de Fabricaciones	Argentina	Westinghouse
18	500	350/1010	600	d-c	Geared	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
19	500	350/1010	600	d-c	Geared	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
20	500	350/1010	600	d-c	Geared	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
21	500	350/1010	600	d-c	Geared	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
22	500	350/1010	600	d-c	Geared	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
23	500	350/1010	600	d-c	Geared	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
24	500	350/1010	600	d-c	Geared	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
25	500	350/1010	600	d-c	Geared	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
26	500	200/600	600	d-c	Geared	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
27	500	200/600	600	d-c	Geared	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
28	500	200/600	600	d-c	Direct	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
29	500	200/600	600	d-c	Direct	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
30	500	200/600	600	d-c	Direct	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
31	500	200/600	600	d-c	Direct	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
32	500	300/1160	600	d-c	Geared	Reversing cold strip mill reel	Stanley Works	New Britain, Conn.	General Electric
33	500	300/1160	600	d-c	Geared	Reversing cold strip mill reel	Stanley Works	New Britain, Conn.	General Electric
34	500	300/750	600	d-c	Geared	Rod mill	South African Iron and Steel Industrial Corp., Ltd.	Pretoria, Union of South Africa	General Electric
35	500	300/750	600	d-c	Geared	Rod mill	South African Iron and Steel Industrial Corp., Ltd.	Pretoria, Union of South Africa	General Electric
36	500	575/1150	600	d-c	Geared	Rod mill	South African Iron and Steel Industrial Corp., Ltd.	Pretoria, Union of South Africa	General Electric
37	500	575/1150	600	d-c	Geared	Rod mill	South African Iron and Steel Industrial Corp., Ltd.	Pretoria, Union of South Africa	General Electric
38	500	400/1200	330	d-c	Geared	2-Stand tandem cold strip mill	Wallingford Steel Corp.	Wallingford, Conn.	General Electric
39	500	400/1200	330	d-c	Geared	2-Stand tandem cold strip mill	Wallingford Steel Corp.	Wallingford, Conn.	General Electric
40	500	225/674	600	d-c	Direct	12–14 in. Merchant mill, stand No. 6	Sheffield Steel Corp.	Houston, Tex.	Westinghouse
41	500	300/900	600	d-c	Geared	12–14 in. Merchant mill, stand No. 3A	Sheffield Steel Corp.	Houston, Tex.	Westinghouse
42	500	300/900	600	d-c	Direct	12–14 in. Merchant mill, stand No. 8	Sheffield Steel Corp.	Houston, Tex.	Westinghouse
43	500	300/900	600	d-c	Direct	12–14 in. Merchant mill, stand No. 9	Sheffield Steel Corp.	Houston, Tex.	Westinghouse
44	500	320	2200	60†	Geared	Sheet mill	Universal Cyclops Steel Corp.	Bridgeville, Pa.	Westinghouse
45	500	500/1000	250	d-c	Geared	Breakdown mill	Lewis Foundry and Machine Co	Czechoslovakia	Elliott
46④	500①	250/965	600	d-c	Geared	Delivery tension roll	Carnegie-Illinois Steel Corp.	Dravosburg, Pa.	Elliott
47④	500①	250/965	600	d-c	Geared	Delivery tension roll	Carnegie-Illinois Steel Corp.	Dravosburg, Pa.	Elliott
48	600	690/850	600	d-c	Direct	No. 2 Stand 2-stand temper mill	Weirton Steel Co.	Weirton, W. Va.	General Electric
49	600	250/1000	600	d-c	Geared	Temper mill reel	Jones & Laughlin Steel Corp.	Pittsburgh, Pa.	General Electric
50	600	400/800	600	d-c	Geared	Rod mill	South African Iron and Steel Industrial Corp., Ltd.	Pretoria, Union of South Africa	General Electric
51	600	400/800	600	d-c	Geared	Rod mill	South African Iron and Steel Industrial Corp., Ltd.	Pretoria, Union of South Africa	General Electric
52	600	400/800	600	d-c	Geared	Rod mill	South African Iron and Steel Industrial Corp., Ltd.	Pretoria, Union of South Africa	General Electric
53	600	400/900	600	d-c	Geared	Rod mill	South African Iron and Steel Industrial Corp., Ltd.	Pretoria, Union of South Africa	General Electric
54④	600②	300/900	600	d-c	Geared	48 in. Skin pass mill reel	A. C. E. C.	Belgium	Westinghouse
55④	600②	450/1000	600	d-c	Geared	Temper pass mill	Carnegie-Illinois Steel Corp.	Dravosburg, Pa.	Elliott
56	600②	450/1000	600	d-c	Geared	Temper pass mill	Carnegie-Illinois Steel Corp.	Dravosburg, Pa.	Elliott
57	700	500/1000	600	d-c	Geared	Rod mill	South African Iron and Steel Industrial Corp., Ltd.	Pretoria, Union of South Africa	General Electric
58④	700	400/800	600	d-c	Geared	Bar mill	Haynes Stellite Company	Kokomo, Ind.	Elliott
59	750	635/1270	600	d-c	Direct	Aluminum foil mill	Aluminum Co. of Canada	Kingston, Ontario, Can.	General Electric
60	750	150/450	600	d-c	Geared	Vertical edger	McLouth Steel Corp.	Detroit, Mich.	General Electric
61	800②	175/575	600	d-c	Direct	60 in. Tandem cold mill reel	Columbia Steel Co.	Torrance, Calif.	Westinghouse
62	800	250/750	600	d-c	Direct	12–14 in. Merchant mill, stand No. 7	Sheffield Steel Corp.	Houston, Tex.	Westinghouse
63	800	350/875	600	d-c	Geared	10 in. Rod mill, stands No. 4, 5, 6	Laclede Steel Co.	Alton, Ill.	Westinghouse
64④	800	440	440	60†	Geared	Scalping mill	Aluminum Co. of America	Davenport, Iowa	Elliott
65④	800	440	440	60†	Geared	Scalping mill	Aluminum Co. of America	Davenport, Iowa	Elliott
66④	800	355	440	60†	Geared	Skin pass mill	Aluminum Co. of America	Davenport, Iowa	Elliott
67	1000	200	2300	60*	Direct	Reroiling mill	Simons Co.	San Francisco, Calif.	Allis-Chalmers
68	1000	200/400	600	d-c	Geared	30 in. Reversing cold strip mill	Greer Steel Co.	Dover, Ohio	Westinghouse
69	1000	300/600	600	d-c	Direct	66 in. Temper pass mill	Columbia Steel Co.	Torrance, Calif.	Westinghouse
70	1000	400/800	600	d-c	Geared	48 in. Reversing cold brass mill	Direccion General de Fabricaciones	Argentina	Westinghouse
71	1000	200/400	600	d-c	Geared	Cold reduction mill	Acciaierie E Ferriere	Milan, Italy	Elliott
72	1250	40/100	480	d-c	Direct	18 in. Blooming mill	Allegheny-Ludlum Steel Corp.	Watervliet, N. Y.	General Electric
73	1250	200/400	250	d-c	Geared	Hot strip mill	Sharon Steel Corp.	Sharon, Pa.	General Electric
74	1250	400/800	600	d-c	Geared	72 in. 3-Stand cold strip mill	Inland Steel Co.	Indiana Harbor, Ind.	General Electric
75	1250	200/600	600	d-c	Geared	12–14 in. Merchant mill, stands No. 4a and 5a	Sheffield Steel Corp.	Houston, Tex.	Westinghouse
76	1250	575/930	600	d-c	Geared	Merchant mill	Morgan Construction Co.	Borlanger-Domnarvet-Sweden	General Electric
77⑤	1500	175/1220	480	d-c	Geared	Reversing hot copper breakdown mill	Revere Copper and Brass Corp.	Baltimore, Md.	General Electric
78⑤	1500	175/1220	480	d-c	Geared	No. 2 Stand of 2-stand cold copper breakdown mill	Revere Copper and Brass Corp.	Baltimore, Md.	General Electric
79	1500	575/930	500	d-c	Geared	Rod mill finishing train	Morgan Construction Co.	Societe Miniere Et Metalurgique de Rodange, Luxembourg	General Electric
80	1500	450	2300	60†	Geared	Cold copper breakdown mill	Seymour Manufacturing Co.	Seymour, Conn.	General Electric
81	1500	250/500	600	d-c	Geared	Reversing cold strip mill	Stanley Works	New Britain, Conn.	General Electric
82	1500	50/90	600	d-c	Direct	48 in. Reversing hot brass mill	Direccion General Fabricaciones	Argentina	Westinghouse
83	1500	300/600	600	d-c	Direct	Hot strip mill	Superior Steel Corp.	Carnegie, Pa.	Westinghouse
84④	1500	300/600	600	d-c	Geared	Bar mill	Haynes Stellite Co.	Kokomo, Ind.	Elliott

ELECTRIC MOTORS OVER THREE HUNDRED HORSEPOWER

(CONTINUED)

Item	Horsepower	Revolutions per minute	Volts	Frequency	Method of drive	Type of mill	Purchaser	Location	Manufacturer
85④	1500	595	2300	60†	Geared	Sheet mill	Haynes Stellite Co.	Kokomo, Ind.	Elliott
86	1700	300/720	600	d-c	Geared	Tandem Cold mill	Bethlehem Steel Co.	Lackawanna, N. Y.	Westinghouse
87	2500	70/120	600	d-c	Direct	60 in. Tandem cold mill, stand No. 1	Columbia Steel Co.	Torrance, Calif.	Westinghouse
88	3000①	40/100	600	d-c	Direct	Reversing blooming and slabbing mill	McLouth Steel Corp.	Detroit, Mich.	General Electric
89	3000①	40/100	600	d-c	Direct	Reversing blooming and slabbing mill	McLouth Steel Corp.	Detroit, Mich.	General Electric
90	3000	150	6600	60†	Geared	Spare for hot strip mill	Great Lakes Steel Corp.	Ecorse, Mich.	General Electric
91	3000	125/312	600	d-c	Direct	60 in. Tandem cold mill, stand No. 2	Columbia Steel Co.	Torrance, Calif.	Westinghouse
92	3500	110/290	600	d-c	Direct	Tandem hot strip mill	Kaiser Co.	Fontana, Calif.	General Electric
93	3500②	125/425	600	d-c	Direct	60 in. Tandem cold mill, stand No. 3	Columbia Steel Co.	Torrance, Calif.	Westinghouse
94	3500②	250/575	600	d-c	Direct	60 in. Tandem cold mill, stand No. 4	Columbia Steel Co.	Torrance, Calif.	Westinghouse
95	4000①	50/120	600	d-c	Direct	45 in. Blooming mill	Societe Lorraine des Acieries de Rombas	France	Westinghouse
96	4000①	50/120	600	d-c	Direct	45 in. Blooming mill	Societe Lorraine des Acieries de Rombas	France	Westinghouse
97	4000	360	11000	60*	Geared	Hot strip mill rougher	Jones & Laughlin Steel Corp.	Cleveland, Ohio	Westinghouse
98	4000	392	13200	60†	Geared	140 in. Plate mill	Lukens Steel Co.	Coatesville, Pa.	Westinghouse
99	4000	50/120	700	d-c	Direct	36 in. Reversing blooming mill	Rotary Electric Steel Co.	Detroit, Mich.	Allis-Chalmers
100	5000	125/250	600	d-c	Geared	Tandem hot strip mill	Kaiser Co.	Fontana, Calif.	General Electric
101	5000	125/250	600	d-c	Geared	Tandem hot strip mill	Kaiser Co.	Fontana, Calif.	General Electric
102	5000	125/250	600	d-c	Geared	Tandem hot strip mill	Kaiser Co.	Fontana, Calif.	General Electric
103	5000②	125/312.5	600	d-c	Direct	42 in. Reversing hot strip mill	McLouth Steel Corp.	Detroit, Mich.	Westinghouse
104⑤	12000②	90	2300	60*	Geared	Billet and bar mill	Republic Steel Corp.	Youngstown, Ohio	General Electric

*Synchronous †Induction motor ①Twin motor drive ②Double armature
General Electric ship propulsion motors purchased from W. A. A. and applied to rolling mills ④Built in 1946 and 1947, previously unreported

RECAPITULATION

Company	Location	Type of mill	Number of motors	Total horsepower
A. C. E. C.	Belgium	48 in. Skin pass mill tension roll	2	950
Acciaierie E. Ferriere	Milan, Italy	Cold reduction mill	1	1000
Allegheny Ludlum Steel Corp.	Watervliet, N. Y.	18 in. Blooming mill	1	1250
Aluminum Co. of America	Davenport, Iowa	Scalping mill	2	1600
		Skin pass mill	1	800
Aluminum Co. of Canada	Kingston, Ontario, Canada	Aluminum foil mill	1	750
Bethlehem Steel Co.	Lackawanna, N. Y.	Tandem cold mill	1	1700
Carnegie-Illinois Steel Corp.	Dravosburg, Pa.	Delivery tension roll	2	1000
		Temper pass mill	2	1200
Columbia Steel Co.	Torrance, Calif.	66 in. Temper pass mill	2	1300
		60 in. Tandem cold mill	5	13,300
Direccion General de Fabricaciones	Argentina	48 in. Reversing cold brass mill	3	1800
		48 in. Reversing hot brass mill	1	1500
Granite City Steel Company	Granity City, Ill.	Skin pass mill	1	400
Great Lakes Steel Corp.	Ecorse, Mich.	Spare for hot strip mill	1	3000
Greer Steel Co.	Dover, Ohio	30 in. Reversing cold strip mill	1	1000
Haynes Stellite Co.	Kokomo, Ind.	Bar mill	2	2200
		Sheet mill	1	1500
Inland Steel Co.	East Chicago, Ind.	2-Stand temper mill	5	2000
	Indiana Harbor, Ind.	72 in. 3-Stand cold strip mill	1	1250
Jones & Laughlin Steel Corp.	Pittsburgh, Pa.	Temper mill reel	1	600
	Cleveland, Ohio	Hot strip mill rougher	1	4000
Kaiser Co.	Fontana, Calif.	Tandem hot strip mill	4	18,500
Laclede Steel Co.	Alton, Ill.	10 in. Rod mill, stands No. 4, 5 and 6	1	800
Lewis Foundry and Machine Co.	Czechoslovakia	Breakdown mill	1	500
Lukens Steel Co.	Coatesville, Pa.	140 in. Plate mill	1	4000
McLouth Steel Corp.	Detroit, Mich.	Vertical edger	1	750
		Reversing, blooming and slabbing mill	2	6000
		42 in. Reversing hot strip mill	3	5600
Morgan Construction Co.	Borlanger-Domnarvet-Sweden	Merchant mill	15	8250
	Luxembourg	Rod mill finishing train	1	1500
Republic Steel Corp.	Youngstown, Ohio	Billet and bar mill	1	12,000
Revere Copper and Brass Corp.	Baltimore, Md.	Reversing hot copper breakdown mill	1	1500
		No. 2 Stand of 2-stand cold copper breakdown mill	1	1500
Rotary Electric Steel Co.	Detroit, Mich.	36 in. Reversing blooming mill	1	4000
Seymour Manufacturing Co.	Seymour, Conn.	Cold copper breakdown mill	1	1500
Sharon Steel Corp.	Sharon, Pa.	Hot strip mill	1	1250
Sheffield Steel Corp.	Houston, Tex.	12–14 in. Merchant mill	6	4050
Simons Co.	San Francisco, Calif.	Rerolling mill	1	1000
Societe Lorraine des Acieries de Rombas	France	45 in. Blooming mill	2	8000
South African Iron and Steel Industrial Corp., Ltd.	Pretoria, Union of South Africa	Rod mill	9	5100
Stanley Works	New Britain, Conn.	Reversing cold strip mill	3	2500
Superior Steel Corp.	Carnegie, Pa.	Hot strip mill	1	1500
Universal Cyclops Steel Corp.	Bridgeville, Pa.	Sheet mill	1	500
Wallingford Steel Corp.	Wallingford, Conn.	2-Stand tandem cold strip mill	2	1000
Weirton Steel Co.	Weirton, W. Va.	2-Stand temper mill	6	2400

Type of motors purchased	Number of motors	Total horsepower
Alternating current motors	11	29,900
Direct current motors	93	107,900
Total	104	137,800

Report of Activities

OF AISE STANDARDIZATION COMMITTEE - 1948

By FRANK W. CRAMER

Chairman, AISE Standardization Committee

▲ A great deal of progress has been made on the Association of Iron and Steel Engineer's Standardization Program since we reported to the Association at the 1947 annual meeting. Of the fourteen active research projects three were completed during the past year, three projects involving a great deal of research work.

The following standardization and research activities are still under way:

1. Plain Bearings.
2. Handbook of Lubrication Standards for the Steel Industry.
3. Fuel Furnace Control and Ceramic Handbook.
4. Flexible and solid couplings.
5. Size, Length, Breadth and Type of Shunting for Motor Brushes.
6. Content and Amount of Dirt in Steel Mill Atmospheres.
7. Steel Mill Lighting.
8. Crane Wiring.
9. Crane Limit Switches.
10. Rolling Pressures and Power Requirements for Rolling Mills.
11. Mill Motor Brake Standardization.

The standards and research work which were completed during the year covered three subjects which concerned themselves primarily with cranes. They are as follows:

1. Crane Ladle Hook Investigation.
2. Design of Hot Metal Ladles.
3. AISE Electric Overhead Traveling Crane Specifications.

The ladle hook and hot metal ladle projects were both research projects which involved testing and analysis of results by the laboratory.

The results of the ladle hook research will be reported later in this session by Professor Carl W. Muhlenbruch of Northwestern Technological Institute, in his paper, "Analytical and Experimental Studies of Ladle Hooks." Professor Muhlenbruch carried out this research at the Carnegie Institute of Technology, and the Association also wishes to express its appreciation for the cooperation which the Weirton Steel Co. extended in permitting tests to be made on hooks in their open hearth department. Professor Muhlenbruch has a tentative recommended design procedure which will be submitted to the Board of Directors for approval. However, the form and details of this recommendation will be dependent on the discussion and comments which you gentlemen will have on this paper at the session. We therefore request that you be very free in criticizing this paper, so that the benefit of your experience may be incorporated in the final standard.

The problem of how to design hot metal ladles is difficult because the stress distribution in such ladles is extremely complicated. The final report on this research program will be given by Mr. Knudsen later in this session in his paper "Stresses in Hot Metal Ladles." This research program is one handled at the Fritz Engineering Laboratory of Lehigh University, where the original crane work was done. The ladle study was carried on by Mr. K. E. Knudsen and also by W. H. Munse and Professor B. G. Johnston, director of the laboratory. The actual design procedures based on this study must yet be submitted to the Standards Committee and the Board of Directors for their approval.

The new revised crane specifications will be published next year. This specification was finally completed and approved by the crane committee representing all steel companies at an all day meeting on August 30th. The new crane specifications involve a number of important additions. All cranes are set up on a service basis and service factors for the various types of cranes are used for gearing and motor design. A new design procedure for determination of bridge and trolley motor size is incorporated in these specifications. This procedure was set up primarily for the new 600 series mill motor, but data is given so that the procedure can be applied also to the design of the old type mill motor. The specification also includes a new gearing design.

This specification is based on the American Gear Manufacturers Association method for determining the strength and durability of gears. The specification is based on the hardness of the material and does not limit the material on which the gearing is made. For example, some people have the impression that the old B_1 and B_2 materials are not allowed by the new gearing specification, but this is not the case and they may be

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used as previously. The horsepower, however, which the new specification will allow may be different than that allowed on the old gearing specification. A number of other minor changes are also included in the new specifications.

One meeting of the plain bearings committee headed by C. E. Pritchard, lubrication engineer, Republic Steel Corp., was held during the year on June 11, 1948. At this meeting the data which this committee had accumulated so far on bearing design was gone over, and as a result of the discussion at this meeting, it was decided that the bearing information and bearings should be broken down into three classifications. These classifications include:

1. Precision bearings under 8 in. in diameter which would include automotive and diesel engine bearings as well as precision spindles, etc., in special tools.
2. Medium fit which might include pumps, compressors, motors, turbine generators, oil flooded roll necks, modern mill tables, finishing machines and some modern roll neck bearings.
3. Loose fit which might include old style roll neck bearings, mine machinery, railroad and old style roll table bearings.

This involves repeating the questionnaire which was previously sent out for information on bearings, but sub-divided so that to obtain the information on the bearing classification basis. This questionnaire is now under way.

Because of a lack of time and available personnel no work has been done on the project, "Handbook of Lubrication Standards in the Steel Industry." For the same reason also no work has been done on the "Fuel, Furnace, Control and Ceramic Handbook."

With the completion of the standards of the new mill motor which was discussed at the last year's convention it was possible to go ahead again on the work of the standardization of couplings. Consequently, information is being gathered again from the various coupling manufacturers by Mr. H. W. Neblett of the Inland Steel Co., who is also chairman on this sub-committee. Because of the fact that some of the manufacturers are modifying their recommendations and designs due to the new motor, some of this information has been slow in getting in. It is expected, however, that the remainder of this information will be gathered shortly.

So far we have not been able to determine whether this dimensional standardization will be possible because of the wide variance in the requirements of the different designs, but we expect to have this information before the meeting next year.

The research project on "Content and Amount of Dirt in Steel Mill Atmospheres," is one which is arousing more and more interest among steel mill engineers because of the regulations being passed by the regulatory bodies and because of the problems which are being added with the use of oxygen in the steel plants. Mr. E. C. McDonald, combustion engineer of Republic Steel Corp., Corrigan McKinney Works, Cleveland, Ohio, was recently made chairman of the committee on this project. He is now developing the program of work which must be done.

The project on "Steel Mill Lighting" which is being headed by Mr. Jess Booth, superintendent of maintenance, Carnegie-Illinois Steel Corp., Duquesne, Pa., is being done in cooperation with the Illuminating Engineering Society. Up to the present time tentative recommendations have been set up for the open hearth department of the steel plant.

This standard recommends how many foot candles should be required to eliminate the various areas of the open hearth for the various operations concerned under the conditions usually encountered. A recommendation is also made as to how the foot candles should be obtained. Work is being continued on the other divisions of the steel plant such as the rolling mill, blast furnace, etc.

The committee on crane wiring which is headed by J. E. Bodoh of the Gary Works, Carnegie-Illinois Steel Corp., Gary, Ind., has been divided into two sub committees, one dealing with crane service classifications and one dealing with wiring details and standards. Because of the various ambient temperatures under which so many cranes must operate, wire sizes are dependent a great deal on the crane service. The wiring sub-committee is studying performance of cable insulations with a view of standardizing and reducing in number the installations to be used. They are analyzing the intermittent cable ratings. Also falling in the scope of their project is a study of standards of conduit fittings and installation details.

This project was as you may know initiated because the latest requirements of the National Electrical Code in their section on crane and hoist wiring are in conflict with the practice of many steel mills. Their study has also revealed so far that wiring standards vary from general statements to complete tabulations and photostatic copies of design details.

Another standardization project which is on the program is an attempt to standardize crane limit switches. This project is being headed by Mr. R. W. Graham, electrical superintendent, Lackawanna Plant, Bethlehem Steel Co., Lackawanna, N. Y. Mr. Graham has the following objectives for the standardization program:

1. The enclosure of the limit switch proper shall be NEMA 1A or better.
2. The resistor may be either open or enclosed in a drip-proof housing.
3. The covers shall be secured to the case by a safety chain.
4. All operating mechanism, except the operating lever and weights, shall be enclosed.
5. Extended leads shall be supplied for all connections.
6. The switch shall be double pole, double-throw arranged to open both sides of the main power circuit, and to connect the circuit for dynamic braking through a resistor.
7. Each pole of the switch shall be provided with a magnetic blowout.
8. The switch shall be gravity or spring tripped and gravity reset.
9. Mounting holes should be interchangeable.
10. Space limitation determined for interchangeability.

In his preliminary work Mr. Graham has tabulated detailed data on the various types of switches.

A new project which has been set up during the past year is one on rolling pressures and power requirements

for rolling mills. This project is one which has been recently established and so far no appreciable work has been done on it. Charles McGranahan, assistant general superintendent, Jones & Laughlin Steel Corp., Pittsburgh, Pa., is the chairman of this committee. This project will probably require experimental work in the mill in which pressures and torques will be measured over an extensive range of sizes and operating conditions during the rolling of various products.

The last project on the standardization agenda is mill motor brake standardization. This project is headed by Mr. V. E. Schlossberg, superintendent, electric power and steam departments, Inland Steel Co., East Chicago, Ind., and Mr. Schlossberg will report to you now the progress that they have made on this subject.

DISCUSSION

PRESENTED BY

V. E. SCHLOSSBERG, Superintendent, Electric Power and Steam Departments, Inland Steel Co., East Chicago, Ind.

V. E. Schlossberg: The joint AISE-NEMA Committee on Brake Standardization met September 8th at the Bismark Hotel in Chicago, Ill.

The wonderful thing about the meeting was that it was about 100 per cent attended. A general discussion took place between the operating men and the manufacturer's representatives and a sub-committee headed by Mr. P. B. Harwood was appointed.

After the meeting was adjourned, the sub-committee met and have turned in a report which I shall quote:

"I believe that you will be interested to know that after the main meeting was adjourned yesterday the design sub-committee remained for some little time and accomplished the following:

1. A table of proposed torque ratings was established which is a little different and we believe better than any which had previously been proposed.
2. The motor frames were matched to the proposed ratings.
3. A series of maximum possible wheel diameters was calculated, based on the dimensions of the motor frames.
4. A series of maximum desirable wheel diameters was established, based on being able to apply an oversized brake to any motor frame.
5. Minimum wheel diameters were established, based on the limitations of desirable wheel length.
6. From these figures a table of proposed wheel diameters and wheel widths was established.

"With this as a start, the brake manufacturers propose to do some preliminary design work to see whether each of them can work out a line of brakes using the proposed figures. It was estimated that it might take from six to eight weeks to do this work."

The brake committee is largely dependent on the brake manufacturers. It appears, however, that the brake manufacturers are going to do a good job and produce a brake which we will be able to apply on both the mill type and general purpose motors without digging a hole to set the brake.

One more major point which we might bring up is that they also attempted to provide a standard brake wheel. In other words, not only will the whole brake be interchangeable from one manufacturer to another but all of the brake wheels will also be interchangeable.

Member: Can you tell me whether that same thing applies to hydraulic brakes?

V. E. Schlossberg: The brake standardization committee started out to work on electric brakes mainly. There was a representative from a hydraulic brake manufacturer at the meeting and his company is going to investigate the problem also.

Make your plans to attend!

ANNUAL SPRING CONFERENCE

ASSOCIATION OF IRON AND STEEL ENGINEERS

LORD BALTIMORE HOTEL BALTIMORE, MARYLAND

MAY 2 and 3, 1949

Coal and Ore Preparation

FOR 2000-TON BLAST FURNACE

. . . . the first 2000-ton blast furnace will probably not be a new, larger diameter furnace, as it appears that the present 28-foot hearth diameter furnace may attain this production by some modification of design and proper preparation of the raw materials . . . . the following paper by Mr. Gardner was presented on October 29, 1948 in Chicago at the Joint Meeting of the Blast Furnace and Coke Oven Association of the Chicago District and the Eastern States Blast Furnace and Coke Oven Association, and Mr. Naismith's paper is abstracted from the one presented at the same meeting . . . .

Coal

By E. J. GARDNER, Superintendent
Blast Furnace and Coke Plant
Inland Steel Co.
Indiana Harbor, Ind.

▲ THE preparation of coals for the production of metallurgical coke has always started at the mine. In the past, the hand loading of coal at the face permitted the use of selective mining methods that produced a high quality product. With the wide adoption of machines to load the coal, the productivity per man was increased but the quality of the mined coal was adversely affected. Bureau of Mines reports on the mechanical loading of bituminous coal underground show that 25 per cent of the production was mechanically loaded in 1938 and by 1946 the amount increased to 58 per cent.

In discussing the preparation of coal for the production of metallurgical coke, we must know the carbonization and expansion properties of the low and high volatile coals used and the percentage of low volatile coal that is required in the blend to produce coke of satisfactory physical structure and strength. Since coke plants vary in the type and number of coals used in their coking blends, this paper will be confined to our operations at Inland.

COALS USED

Our practice is to carbonize a mixture of 35 per cent Pocahontas No. 3 seam coal purchased in the open market from a minimum number of mines and 65 per cent Elkhorn No. 3 seam from our own mine at Wheelwright, Ky.

We use a movable wall expansion test oven to evaluate the carbonization and expansion properties of the low and high volatile coals that we use regularly, and in the selection of satisfactory coking coals to supplement our supply. Our expansion tests show that for our practice where we crush coal so that 80 per cent passes

Figure 1 — The 2000-ton blast furnaces of the future will probably be furnaces similar, except for slight design changes, to those shown in the illustration which have hearth diameters of 27 ft 6 in., and except that much greater care will have to go in preparation of the raw materials.

through a ⅛ in. square mesh screen, using a blend of 35 per cent low and 65 per cent high volatile coals—3.50 psi is the maximum expansion pressure of the blend that we can charge safely in our ovens.

Along with other plants in the industry, we have also had to carbonize higher ash coals. When our Wheelwright mine, due to the shortage of manpower and the demand for increased production for the war effort, went from their customary practice of careful preparation of the coal at the face, followed by hand loading of the coal into the mine cars to the present practice of machine loading, the ash content of our Wheelwright slack was increased from 4.00 per cent in 1941 to 7.45 per cent in 1948.

During the same period, the ash content of our purchased Pocahontas coal increased from 5.70 to 7.15 per cent. The increase in ash in our coal blend produced furnace coke that was high in ash and inferior in physical properties and resulted in a decrease in the iron tonnage produced at our blast furnaces.

Faced with the prospect of having to use extremely high ash coal for a number of years, we are installing a coal cleaning plant at Wheelwright. Our mining staff assures us that they will deliver washed Wheelwright coal from machine loaded mining with an ash content similar to the hand loaded product.

Comparative coal and coke analyses, physical properties of the furnace coke and blast furnace operating data for hand loaded and machine loaded coal are given in the following tables:

INLAND STEEL COMPANY

COKE OVEN AND BLAST FURNACE DATA

	1941 (January through September)			1948 (January through September)		
	Per cent in mix	Ash	Sulphur	Per cent in mix	Ash	Sulphur
Pocahontas	35	5.70	0.62	35	7.15	0.65
Wheelwright slack	40	4.00	0.74	36	7.45	0.89
Wheelwright egg	25	1.90	0.65	17	4.10	0.80
Miscellaneous high volatile	..	..	..	12	8.40	0.93
Mixture	..	4.00	0.67	..	7.35	0.81
Coke	..	5.30	0.57	..	10.00	0.71

PHYSICAL TESTS ON FURNACE COKE

Average size — inches	2.06	2.41
Shatter test, +2 in.	55.2 per cent	64.9 per cent
Tumbler test		
Stability +1 in.	52.6 per cent	44.5 per cent
Hardness +¼ in.	68.0 per cent	63.9 per cent
Minus 2 in. coke	48.90 per cent	35.70 per cent

BLAST FURNACE OPERATIONS

No. 1, 2, 3, 5 furnaces		
Iron — tons per day	3894	3452
Coke — lb per ton of iron	1556	1802

The table shows that the ash in the Pocahontas coal increased from 5.70 per cent in 1941 to 7.15 per cent in 1948.

For the same periods, the ash in the Wheelwright slack increased from 4.00 to 7.45 per cent.

The ash content of our coke increased from 5.30 per cent in 1941 to 10.00 per cent in 1948.

In the physical properties of the coke, the average size increased from 2.06 inches for the low ash coke in 1941 to 2.41 inches for the high ash coke in 1948.

The strength of the coke, as measured by the tumbler stability and hardness factors, decreased from 52.6 and 68 per cent in 1941 to 44.5 and 63.9 per cent, respectively, in 1948.

The total iron production of No. 1, 2, 3, and 5 furnaces decreased from 3894 tons per day to 3452 tons per day. This amounts to an 11.3 per cent decrease in iron tonnage.

For the same periods, the coke consumption increased from 1556 lbs to 1802 lbs coke per ton of iron.

STORAGE OF COAL

In the storing of coals our experience has been that a very appreciable increase in uniformity of ash content of coke can be obtained by following a carefully supervised program of putting coal into stock and taking it out in such a way as to give the coal a maximum amount of mixing. Our practice is to stock all the coal as it is received by cargo during the summer months and by railroad cars during the winter months.

The coal boats are unloaded by bridges equipped with six ton buckets. These bridges transfer the coal from the boat to the coal storage bunkers located at our plant dock. The bunkers discharge the coal through doors in the bottom onto a belt running the entire length of the bunker. This coal is transported to the coke plant coal storage field by a series of belt conveyors terminating in three coal bridges which traverse the coke plant stockpile.

The coal is discharged into the coal storage field by the coal bridge conveyor and tripper, forming piles in the shape of small pyramids. The space between adjoining pyramids is filled with other pyramids to within a few feet of the bridge conveyor level.

In reclaiming from stock, the coal from two different benches or levels is picked up alternately to obtain a uniform mixture of the coarse coal which tends to roll and segregate at the bottom of each small pyramid and the finer sizes of coal at the apex. A careful record is kept of the age of the coal in stock and the oldest coal is used. New coal is not stored on top of old coal.

COAL PREPARATION

When the low and high volatile coals are taken from storage, they are first run to a roughing bin, then through the Bradford breakers and hammer mills. The pulverized coals—90 and 80 per cent through a ⅛ in. screen for the low and high volatile coals respectively—are then conveyed to the storage bins in the mixer building where there is one bin for low volatile and two bins for high volatile coal. The coals discharged from these bins pass over weightometer operated belts and then over a paddle mixer at the junction of the three

belts. The mixed coal is then transported by conveyors and passes over an additional mixing paddle as it enters the battery storage bins.

COKE QUALITY

From our previous investigation on the effect of coke quality on blast furnace iron tonnage, we know that for maximum iron production the blast furnace must be charged with metallurgical coke made from blends of the highest grade low and high volatile coking coals available.

Studies on the effect of increased ash content of our coke on pig iron tonnage produced, indicate that for each 1 per cent increase in ash in our coke there was a loss of production of 1.9 per cent in pig iron and a seventeen cents per ton increase in the cost of producing iron.

Assuming that we can continue purchasing Pocahontas coal (¾ in. slack) with 7 per cent ash and 0.65 per cent sulphur, and our washed Wheelwright (2 in. slack) has 4 per cent ash and 0.75 per cent sulphur, and we carbonize a blend of 30 per cent low and 70 per cent high volatile because the expansion pressure of the 35 per cent low and 65 per cent washed Wheelwright blend may be above our safe limit, we should produce furnace coke with 6 per cent ash and 0.62 per cent sulphur.

In addition to a satisfactory chemical analysis, it is essential that the physical properties of the coke produced for use in a 2000-ton blast furnace should show maximum resistance to crushing and abrasion: In order to produce the top quality coke, it will be necessary that the low and high volatile coals be pulverized so that at least 90 and 80 per cent respectively pass through a ⅛ in. square mesh screen.

Coke produced from a 30 per cent Pocahontas-70 per cent washed Wheelwright blend under these conditions should show a tumbler stability factor of 50-52 per cent and a tumbler hardness factor of 65-67 per cent and should have the desirable physical properties that are required for maximum iron production in the blast furnace.

Ore

By S. NAISMITH
Ore Evaluation Engineer
Oliver Iron Mining Company
Duluth, Minn.

The heavy demands on the steel industry during and since the end of World War II, coupled with higher costs for labor, maintenance, coke and replacement of facilities, warrant a close inspection of the ways in which blast furnace capacities may be increased. One important factor which can play a part is the improvement in quality of raw materials. This brief discussion covers the possibility of increasing production of a 28 ft diameter hearth blast furnace to 2000 tons per day, based on tests made to determine the benefits to be derived from physical preparation of Mesabi ores for blast furnace operation.

Data from tests conducted at the Edgar Thomson Works, Carnegie-Illinois Steel Corp. have been previously reported by Mr. Herman Dobscha before the A.I.M.M.E. in a paper, "Effect of Sized and Sintered Mesabi Ore on Blast Furnace Practice." These tests were carried out by charging various combinations of ores to two identical blast furnaces of 27 ft 6 in. hearth diameter. A mixture of beneficiated ore was charged in one furnace for a continuous period of one month and normal ores charged in the other furnace. During an interim period of one month, the burdens were reversed and the tests continued for two months.

The furnace charged with beneficiated ore produced 1605 net tons of iron per day, 21.2 per cent more than the normal furnace; produced 227 pounds of dry flue dust and sludge per net ton of iron, 20.1 per cent less than the normal furnace; consumed 1510 pounds of coke per net ton of iron, 15.3 per cent less than the normal furnace; and consumed 677 pounds of flux per net ton of iron, 32.8 per cent less than the normal furnace. The data from the phase of the tests employing sintered ores gave results which were the most outstanding.

Many operators and engineers have been convinced that with additional improvement in ore structure and coke quality, a production rate of 2000 net tons of iron per day is obtainable from furnaces having lines similar to the recently constructed 28 ft. hearth diameter furnaces. Although the performance record mentioned above is remarkable and can undoubtedly be attributed mainly to the improved structure of the prepared ore, it must be remembered that it would be impossible to duplicate the chemical quality of the prepared ore used in the foregoing tests on a large scale operation. Therefore, it is evident that the optimum physical and chemical characteristics which are obtainable by beneficiation of available Mesabi ores would have to be realized before as much as 2000 tons of iron per day could be produced from a 28 ft hearth diameter furnace. Other measures, now under study and test, might add their benefits to those derived from the treatment of raw materials and thus lead farther toward the goal.

In view of the prospective chemical analyses of Mesabi ores, it is doubtful whether ore structure could be improved to the extent necessary to enable production of 2000 tons of iron per day from a 28 ft hearth diameter blast furnace.

Processes employed to beneficiate the structures of Mesabi ores would have to be designed to eliminate potential flue dust, provide optimum permeability, bulk density and reducibility of coarse ore and agglomerate, and provide uniformity of chemical and physical properties. The beneficiation of structure of all Mesabi ores would be a tremendous project involving large capital expenditures.

The trend of ore shipments from the Mesabi range shows a deterioration in iron to silica ratios (the silica content per ton is higher at the expense of a reduction in iron content of the ore) and improvement in structure is due primarily to gradually increasing percentages of concentrates in the total shipments.

Fast Open Hearth Charging

. . . . discussing two innovations in open hearth design that open up some interesting possibilities . . . . patent for these features, which cover a speedy method of charging and an unusual method of tapping, has been applied for by the inventor, Fredrick W. Gumpp, of Massillon, Ohio . . . .

▲ SINCE the inception of the open hearth furnace, its design has followed the same general pattern. Although vast strides have been made in furnace capacity, efficiency and production rate, these improvements have come principally through enlargement, better refractories, closer control, and refinement in design and proportions. No change has occurred in the basic principles of operation.

Instigated principally by the prevailing scrap condition, which is holding down the nation's steel production quite materially, some modifications in design have evolved, pointed toward speeding up furnace charging. The changes suggested would also reduce the capital investment required through elimination of considerable heavy equipment.

The new design, in general, follows the lines of the conventional furnace, although it is suggested that the regenerator chambers might be constructed at ground level at each end of the furnace in order to further reduce investment cost. The new design, however, leaves convention behind, in that the main roof of the furnace, between knuckles, bears on skewbacks which in turn are carried on vertical plunger rods which are part of hydraulic jacks. Thus, the main roof section between knuckles can be raised and lowered. Instead of hydraulic jacks, an overhead crane may be used to raise the roof section if desired.

Running along each side of the furnace are charging platforms, with the inner edges pivoted to a supporting column and the outer edges supported by the plunger elements of jacks in a second hydraulic system. These charging platforms extend for the entire length of the movable roof section, and receive the scrap that is to be charged into the furnace. Auxiliary hoppers, hinged at the inner ends of the charging platforms, (see Figure 1) may be used for miscellaneous materials, such as limestone, lime, manganese, carbon, etc. The auxiliary bins may be collapsed, as shown in the left of Figure 1 to form a chute for the scrap entering the furnace. When

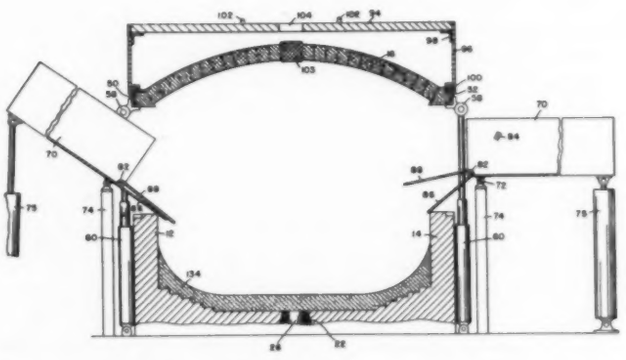


Figure 1 — Cross-section of furnace with movable roof section raised to permit charging. The charging platform (70) on the left is in tilted position to chute scrap into the furnace. The platform (70) on the right is in a normal horizontal position, but the auxiliary collapsible hopper (86-88) is shown in position to discharge miscellaneous material into the furnace. Hydraulic jacks are shown at 60 and 75, for moving the roof and for tilting the charging platforms, respectively.

the auxiliary bin is pulled up into its normal position (see Figure 3), it forms the inner side of the charging platform.

Thus, while a heat is in progress, scrap for the next heat may be placed in the charging platforms, directly from railroad cars, by magnet crane or similar means. When it is time to charge the heat, the roof is raised, the charging platforms tilted, and the scrap slides into the furnace. This operation is completed very rapidly, and the movable roof section is then lowered and melting begun. If recharging is necessary, it is again but a matter of seconds to put more scrap into the furnace.

Another departure from the usual open hearth design lies in the method of tapping. Instead of the usual tapping hole extending out through the back of the furnace, this design is provided with a pouring nozzle built into the bottom of the furnace hearth, as shown in Figure 2.

When it is time to tap the heat, a combination stop-

per rod and drill is inserted through a hole in the roof immediately over the tapping nozzle in the hearth. Rotation of the stopper rod, which carries at its lower end a cutting tool, forms a seat for the stopper rod in the furnace hearth. A drill may then be inserted through the hollow center of the stopper rod and rotated until it pierces through the furnace bottom. The heat can then be tapped by raising and lowering the stopper rod as desired. The mechanism for rotating, raising and lowering the stopper rod and drill is contained in a unit at the top of the rod (see Figure 3).

Molten metal flowing from the furnace may pass directly into ingot molds which pass beneath the tapping nozzle, or into a suitable casting machine, or into a ladle. Thus, ingots may be poured direct, or pig scrap or hot metal made for further refining in electric furnaces, open hearth furnaces, etc. All, or any part, of the molten metal can be tapped, and any desired alloying element or other agent can be added to the metal through the hollow stopper rod. Any desired analysis can therefore be produced.

When the tap has been completed, material may be rammed through the hollow stopper rod into the hole that was drilled through the furnace bottom. The pouring nozzle may then be replaced. Finally, the stopper rod assembly is removed and the rod seat in the hearth is dressed over.

It is apparent that the charging method permits the use of various grades of unprocessed scrap, from light, bulky material to large, oversize sections. Hence, a cheaper charge material is possible. Since little or no scrap preparation is necessary, most of the scrap can be unloaded directly from railroad cars on to the charging platforms of the furnace, thus eliminating charging machines, charging boxes and buggies, and reducing scrap yard requirements materially.

The tapping feature also eliminates some of the conventional expensive equipment, to an extent depending on whether ingots, pig scrap or hot metal is desired from the process.

The operating crew for a unit having these new features might well be considerably smaller than for conventional open hearth installations, while the rapid charging should result in maximum production, with consequent reduced operating costs.

The innovations in the general plan are more readily applicable to new melting units than to existing facilities. The tapping and pouring method, with the layout it requires, might be impossible to put into an existing open hearth shop. However, the charging method can, by moderate changes, be applied to many existing shops, which might gain considerable production through the fast charging thus afforded.

Study of the features offered by this new design opens up some interesting possibilities beyond its use in existing steel plants. Because much of the heavy equipment normally required in an open hearth plant is unnecessary, one or more of these melting units might be constructed in a scrap-producing area at a cost that will permit profitable operation, producing ingots for rolling or, if residuals make this impossible, controlled heavy melting scrap. Special scrap to meet the requirements of foundries or other processes may be a profitable product in some cases.

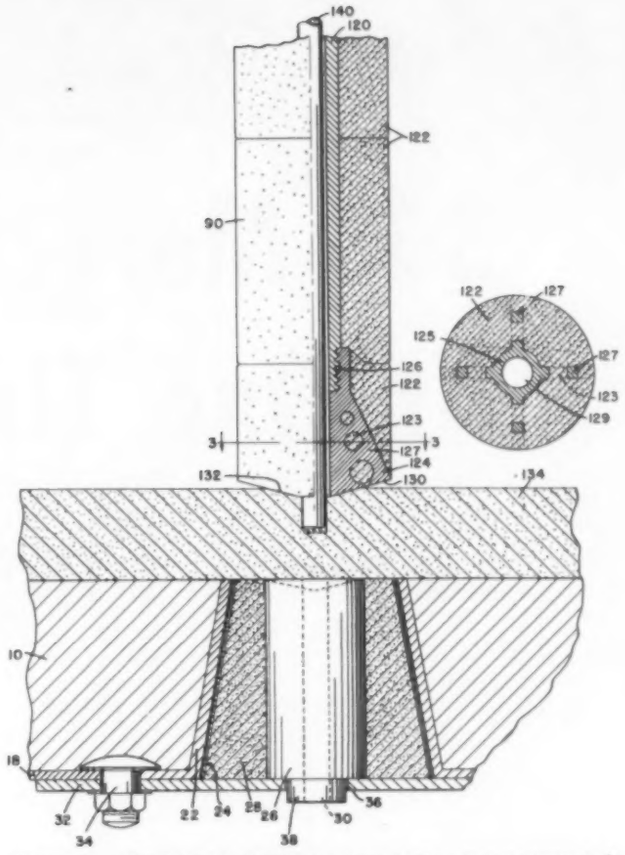
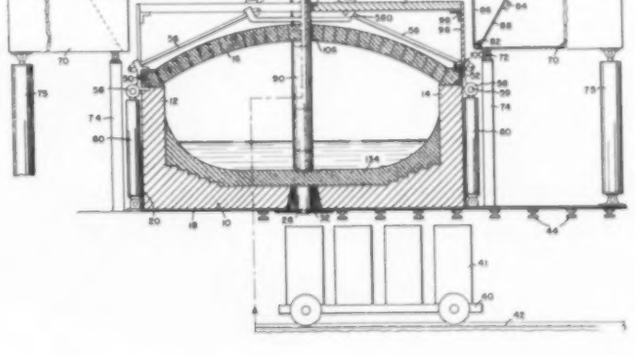


Figure 2 — Sectional detail of tap hole arrangement in hearth of furnace. Stopper rod (90) is composed of a hollow casing (120) covered with refractory sleeves (122). Threaded on the lower end of the casing is a cutting tool (124) which forms a seat in furnace bottom (134) when the rod is rotated. A drill (140), lowered through the hollow casing of the stopper rod, is rotated and cuts through the bottom. A nozzle brick (26) is held into a suitable conical shell (22) by rammed refractory (28) and a cover plate (32).

The flexibility of application of the melting unit covered in this patent is such that it might well be of interest to open hearth and electric furnace operators, foundry groups, scrap dealers, or scrap producers.

Figure 3 — Cross-section through furnace with movable roof section in working position, and with tapping rigging lowered into place through the roof. The stopper rod (90) is carried by a mechanism (92) that rests upon a platform (94) and contains the means for rotating the stopper rod and the drill which passes through the rod. Steel tapped from the furnace may flow into ingot molds, as shown here, or into a ladle or a casting machine.



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. . . Chief Electrician,
Twin Coach Co., Kent, Ohio

. . . "Thanks to . . . .

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Date-line Diary...

December 1

▲ The Lukens Steel Company has started electrification of its 140 in. mill. A new 4000 hp motor will replace the 2250 hp steam engine now running the mill.

▲ The Republic Steel Corporation, 19 fabricators of culvert pipe as well as Toncan Culvert Manufacturers' Association were charged in the Federal Court at Cleveland, Ohio with a civil anti-trust complaint, that they were restraining competition in the manufacture and sale of corrugated sheet metal and culvert pipe. Republic Steel Corporation stated that the sales practices, to which the government objects, have been standard in the culvert industry for nearly one-half century. In addition the sales contracts to which the government objects have heretofore been cancelled. They also said that Republic has no relations with customers except as suppliers of steel sheets.

▲ American Iron and Steel Institute announced that automobile manufacturing, diesel engines, tractors and heating furnaces as well as the expansion of the oil and gas industry has required more than one-fifth of the finished steel production since the end of the war.

December 2

▲ The Lorain Works of National Tube Company set a new all-time high record for the production of steel ingots with a total of 166,250 tons in November. This production was turned out by twelve open hearth furnaces and two bessemer converters.

December 3

▲ The Carnegie-Illinois Steel Corporation announced plans for consolidating the Youngstown district operations at the company's Ohio and McDonald works effective January 1. The primary move involves the transfer of production from the Upper Union Mills to the McDonald Works.

▲ Since 1938 steel capacity has increased 17.5 per cent, or more than 14,000,000 tons. This is faster than the population of the continental United States has increased since the latter figure has been upped only about 12.5 per cent. Additional steel capacity has been accompanied by an increase of 19 per cent in blast furnace capacity.

▲ The Canadian government announced today that they would put up a $30,000,000 loan for the construction of a steel mill in British Columbia if the local interests would match this amount and provide the know-how.

December 4

▲ Edwin G. Nourse, Chairman of the Council of Economic Advisors, told Mr. Truman that consumer prices were showing signs of a flattening out. Dr. Nourse however warned that if military spending were increased over $15,000,000,000 in the next fiscal year this might be a step towards inflation.

▲ According to Ward's Automotive reports, automobile and truck output in the United States and Canada rose to a new post war high of 125,156 vehicles for this week.

December 5

▲ Domestic freight car deliveries during November totaled 9286 compared with October's production of 8934 cars. New car orders during November totaled 4852 cars.

December 6

▲ The Inland Steel Company has announced plans for enlarging steel production. capacity 15 to 20 per cent. This will be done by enlarging and modernizing existing equipment but without the addition of new furnaces or mills. Tin mill production will be increased by the addition of new and more efficient finishing facilities including additional electrolytic tinning lines.

▲ Primary aluminum production during October was 109,053,311 lb. This is about the same rate as the previous two months.

▲ The operating rate of steel companies having 94 per cent of the capacity for the industry will be 100.0 per cent of capacity for the week beginning December 6th. This is equal to 1,802,500 tons of steel compared with 1,804,300 tons one week ago.

December 7

▲ Shipments of steel products in the first ten months of 1948 were 54,183,000 tons or an increase of 1,879,000 net tons over the similar 1947 period. The greatest increase in tonnage so far this year over the corresponding period in 1947 has been in sheet and pipe.

December 8

▲ The Electro Metallurgical Sales Corporation announced that increased power and raw material costs necessitate price increases on some silicon alloys and ferro-columbium effective January 1, 1949. The new base price for 50 per cent ferro silicon is 11.3 cents per lb of contained silicon. Other increases are 1.0 cent a lb of contained silicon on 65 per cent ferro silicon; 0.5 cents a lb of contained silicon for 75 per cent ferro silicon. Ferro-columbium was increased 15 cents a lb of contained columbium for a new base price of $2.90.

▲ The Census Bureau announced that the dollar value of exports in October was the highest since May, with a figure of $1,020,-800,000.

▲ Postmaster General Donaldson states that he intends to ask the new Congress to boost rates on all mail except first class.

December 9

▲ Carnegie-Illinois Steel Corporation announced that price of tin products would be raised effective January 1, 1949. Some of the new prices are as follows per base box of 100 lb: $6.45 for electrolytic tin plate with 0.25 lb coating; $7.50 for hot dipped tin plate with 1.25 lb coating (pot yield). These prices are effective for the entire calendar year.

▲ It is estimated that exports of iron and steel products for 1948 will be about 4,500,000 tons or 2,000,000 tons less than in 1947.

▲ United States Steel Corporation, Bethlehem Steel Company and Republic Steel Corporation told the Capehart Committee that they would absorb freight charges to meet competition if permitted by law to do so.

▲ It is estimated that Canadian steel production in 1948 will have reached a new high of 3,100,000 net tons of steel ingots.

▲ For the first time the monthly pay roll of the iron and steel industry exceeded $200,000,000. This occurred in October for which month the payroll was $201,668,000. Earnings of hourly piecework and tonnage workers average $1.699 per hour or 1.9 cents less than the record September average. The average work week in October was 39.5 hours.

December 10

▲ National Steel Corporation announced new prices on steel mill products for the year 1949. Mr. Weir stated that the prices for 1949 on the various grades of tin plate average $7.00 per base box.

December 11

▲ Ward's Automotive Reports stated that motor trucks have been restored to a buyers market in all weight categories except the light models. They predict that a falling off in demand will cut truck production 10 to 15 per cent in 1949 over 1948 figures.

December 13

▲ The Sharon Steel Corporation has turned over its Dearborn, Michigan seamless tube mill to McCarthy International Tube Company who plans to use the mill's output in its oil operations.

▲ Ground was broken today for a second blast furnace and a third coke plant at the Fontana steel plant of the Kaiser Company. It is estimated that this work will be completed by the end of 1949. This constitutes the $17,000,000 expansion program announced by Mr. Kaiser in September.

▲ The last of the ore freighters unloaded their cargoes today to close the 1948 Lake ore shipping season. Shipments for the season totaled 82,937,291 tons compared with 77,898,087 tons last year.

▲ The operating rate of steel companies having 94 per cent of the steel capacity of the industry will be a 100.0 per cent of capacity for the week beginning December 13th. This is equivalent to 1,802,500 tons of steel or the same as one week ago.

December 14

▲ It is estimated that the demand for petroleum products in 1949 will be about 6 per cent above those in 1948.

▲ The Lebanon Steel Foundry released information today on a new process for the production of steel castings for jet engines. The method uses special permanent metal dies in order to get the contours required in the castings.

December 15

▲ It is expected that the Westinghouse Electric Corporation will supply about $15,000,000 worth of electrical equipment for a new $50,000,000 rolling mill which will be purchased in this country by a group of eight French steel concerns operating under the name of Sollac. Steel mill facilities include a 46 in. blooming mill; a 66 in. hot strip mill; a 44 in. 5-stand tandem cold mill; a 66 in. 3-stand cold sheet mill, and an electrolytic tin plate line.

December 16

▲ The majority stock of Hamilton Steel Company of Cleveland, Ohio was purchased by the Fort Duquesne Company of Pittsburgh, Pa.

December 17

▲ The Reynolds Metal Company announced that they shipped more than 428,500,000 lb of aluminum in 1948.

▲ H. G. Batcheller, president of Allegheny Ludlum Steel Corporation, stated today before the House-Senate Economic subcommittee that a fourth round of wage increases will mean further price boosts.

December 18

▲ A White House Emergency Board recommended a 40 hr week for 1,000,000 non-operating railroad employees with no reduction in the present weekly pay. It proposes that the 40 hr week be put into effect September 1, 1949. The Board also asks for an immediate 7 cent hourly wage boost retroactive to October 1 with another 20 per cent pay rate increase next September. Unions will be free to strike on January 17 if no settlement has been reached.

▲ The Lincoln Electric Company distributed $3,821,973 in incentive payments to 1097 workers for the year 1948. On the average these payments double the income of every member in the organization.

December 19

▲ Shipments of German scrap to the United States reached 80,000 long tons in November. Beginning October 1st, the price of steel scrap in Bizonia was set at $28.50 per long ton free alongside German port.

December 20

▲ The Carnegie-Illinois Steel Corporation and the American Steel and Wire Company announced reductions for price extras for several stainless steel products. The average reduction is about 5 per cent. Products affected are plates, sheet, hot and cold finished bars, structural shapes, hot and cold rolled strip and forging billets and wire.

▲ The operating rate of steel companies having 94 per cent of the steel capacity of the industry will be 88.6 per cent of capacity for the week beginning December 20. This is equivalent to 1,597,000 tons of steel ingots and castings compared with 1,802,500 tons one week ago.

December 21

▲ Iron ore consumption up to December 1st was 73,236,291 tons compared with 73,735,969 tons for the same period one year ago.

December 22

▲ The total bookings of fabricated steel products for the first eleven months of 1948 are estimated to be 1,792,784 tons or an increase of 21 per cent for the corresponding period of 1947.

▲ The Lukens Steel Company announced that they propose to electrify their 206 in. mill at a cost of $1,715,000. The program will take twelve to fifteen months to complete. Twin motors of 8000 hp capacity will be connected through a direct drive on the working rolls. This mill is the largest in the world.

December 23

▲ The Westinghouse Electric Corporation produced and shipped $873,342,638 of electrical equipment and household appliances in the first eleven months of 1948. This is 6.5 per cent more than in all of 1947. The backlog on orders in December was slightly higher than at the end of 1947.

▲ The Esso Standard Oil Company announced a reduction of 25 cents a bbl in heavy fuel oil. Last month this oil was cut 20 cents a bbl. Diesel fuel oil prices were cut one-fifth cent per gal. Esso, however, will raise wholesale gasoline prices one-half cent a gal.

December 24

▲ The New York Central System announced that they have ordered 5350 new freight cars which will cost about $28,400,000. Construction of freight cars in the United States in 1948 was the highest since 1924 and approximately 112,000 were delivered during the year for an average of 9300 cars monthly.

December 27

▲ The operating rate of steel companies having 94 per cent of steel capacity for the industry will be 97.3 per cent for the week beginning December 27th. This is equivalent to 1,753,800 tons of steel ingots and castings compared to 1,597,000 tons one week ago.

▲ General Electric Company announced immediate increases in prices of motors rated 50 hp and above of about 5 per cent. Large turbine-generators of 20,000 kw and higher went up 10 per cent. At the same time the amount by which contract prices on heavy electrical equipment can be increased was reduced to 10 per cent from the 20 per cent limit in effect during 1948.

December 29

▲ The first hot rolled coils on the revamped mill of the Geneva Steel Company were rolled today. This project consists in converting the plate mill to provide facilities for rolling coils which will be shipped to the new cold reduction mill of the Columbia Steel Company at Pittsburg, Calif.

December 30

▲ Steel capacity of the American Steel and Wire Company's Duluth Works will be increased 243,000 tons a year or about 25 per cent.

▲ The Westinghouse Electric Corporation announced that the ceiling on adjustable prices on apparatus lines is being reduced from 20 to 10 per cent. At the same time price increases of 5 to 10 per cent have been announced on certain apparatus lines.

▲ The Great Lakes Steel Corporation completed relining of one of its blast furnaces in thirty-eight days, which is seven days less than the company's previous record for such a job. The furnace had been in operation for 5½ years.

▲ The Railroads were granted temporary freight increases averaging slightly more than 5 per cent by the Interstate Commerce Commission. Most railroads will put these increases into effect on January 6. These increased rates will continue until the ICC acts on the railroads' request for permanent boosts of about 13 per cent.

December 31

▲ The Bethlehem Steel Company plans to offer in the near future $50,000,000 worth of bonds and 627,960 common shares, which capital is to be used for additional steel plant facilities and development of raw material supplies.

▲ Steel production in 1948 is estimated at about 88,500,000 ingot tons. Total payroll for the year is about $2,230,000,000 and employment averaged about 634,000 persons during the year.

Engineered Instrument Panel Boards

By J. W. FRIEDMAN
Application Engineer
Brown Instrument Co.
Philadelphia, Pa.

▲ Industrial process control in many cases is accomplished by the use of a number of individual instruments and accessories combined into a system. Once the correct combination of control equipment has been determined, the problem of proper location, wiring, and mounting of the various units is of prime importance.

Whether the control system is relatively simple, comprising only a few units, or it is more complex, involving a number of controllers and auxiliary devices—such as relays, timers, push-buttons, signal lights—central mounting of as much of the equipment as possible on a panel board has proven advantageous. Chart records of related process variables are grouped together and located at the convenient height for a single supervisor to see at a glance the conditions and progress of the operation. Adjusting knobs for controller set points, timers, or manual loading stations, as well as push-buttons, are at his fingertips to provide such adjustments as may be required during the course of the process.

Instrument engineers in large petroleum, steel, and chemical companies are fully cognizant of the benefits derived from centralized instrument panel boards, and have competent staffs to design and install them. Smaller users, however, or those without the experienced and skilled personnel required, are turning to instrument manufacturers for the know-how and engineering service required to properly design panel boards. In such cases, a completely engineered, packaged unit with the equipment mounted, wired, and piped at the factory offers many advantages and economies.

The primary benefit derived from placing full responsibility for panel work on the instrument manufacturer is that the user is relieved of intricate and time-consuming details, such as: proper panel layout for fabrication and drilling, selection of correct fittings and accessories for wiring and piping, obtaining and mounting of the various units, actual wiring and piping on the back of the board, and preparation of wiring and piping diagrams for external connections.

An added advantage of the factory wired and piped panel is the ease with which it can be placed in operation in the plant. Upon receipt of the unit at the process area, the user need only make a few electrical and piping connections to the supply lines, valves, and the like, in order to have the control system ready for its prescribed functions.

As a basis for panel board design, it is necessary to consider various types of panels available, selecting the one most suitable for the size required, as well as the space limitations and atmospheric conditions at the desired location. Panels most commonly used may be listed under five basic types as follows: full-length panel, part-length panel, cubicle, multi-section panel, and console panel.

In approaching the problem of a panel make-up, the designer considers four primary factors which are in the order of their importance: what equipment is to be mounted on the panel; which panel units must be accessible and viewed from the face of the panel and which can be mounted on the rear; what type of panel is desired; what is the best arrangement of units on panel face from the standpoint of utility and appearance.

The prerequisites to final panelboard design are: a complete list of units to be mounted on the panel, detailed drilling dimensions of each item, and the preliminary design sketch.

The general rules for location of equipment are as follows:

Workmen are shown completing a factory-wired and piped cubicle.

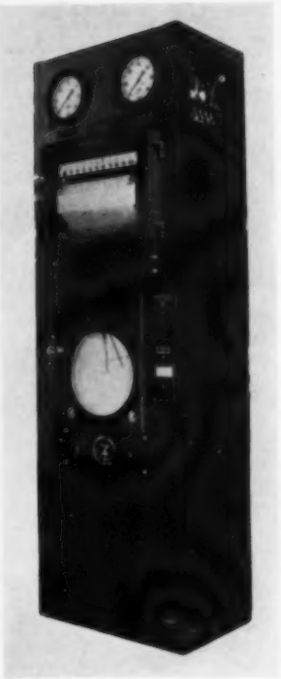
1. A minimum distance of three inches between units or from any unit to the edge of the panel is maintained.

2. Measuring and controlling instruments are located near the top of the panel with the scale at "eye level."

3. Signal lights are located near the top, except where placement near an instrument is desirable because of their function in the system.

4. Timing device with dials and knobs used in adjustments can be made by the operator without undue stretching or stooping. A minimum distance of 30 inches from the floor is usually observed.

5. When functions are performed by several instruments or auxiliary



Typical full-length panel, front and rear views, with enclosed wiring in both flexible and rigid conduit, showing a relatively complex array of relays, timers, and other accessory equipment.

devices in sequence, it is normally desirable to locate them in relative positions corresponding to the order in which they function.

6. When panel mounted components of more than one control system are involved, each is grouped together and separated as much as possible from the other to avoid confusion.

7. Where a unit must be surface mounted, careful consideration of its location is necessary so that it is least likely to interfere with observation or operation of adjacent equipment.

8. The panel is designed to present a symmetrical appearance pleasing to the eye without sacrificing utility.

The fact that four different types of panel wiring are available is not generally known. The four basic types of panel wiring may be classified as follows: Type A with open wiring between devices only. The wires are grouped and tied into cable form. The user, in turn, makes field connections to the terminals within each unit. Type A wiring should be used only where the wired system is quite simple, such as proportional control, with the control instrument and a balancing relay.

Type B with open wiring between devices and to numbered terminal blocks. Here again the wires are grouped and tied into cable form. This type is popular because it is the most economical in the long run and requires a minimum of field connections by the user. Type C with enclosed wiring in flexible or rigid conduit between devices only. This type is identical to Type A, except that a flexible or rigid conduit replaces the open wiring. Type D with enclosed wiring in conduit between devices and terminal blocks in compartments. This type of wiring provides total enclosure of all wiring. It is more desirable than Type C in that the panel is received by the user as a completely wired unit, requiring only control connections to externally mounted equipment.

In addition to cost considerations, there are several factors affecting the selection of open or enclosed wiring. When it is advisable to guard the wiring against mechanical injury or to provide further protection from extreme ambient temperatures, or wet and harmful atmospheres, enclosed wiring is recommended. In general, open wiring meets most requirements in these respects but the local electrical code should be consulted in all cases.

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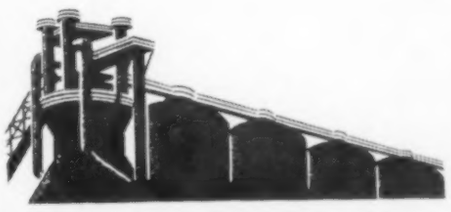

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New Hot Strip Mill in Operation At Superior Steel Corp.

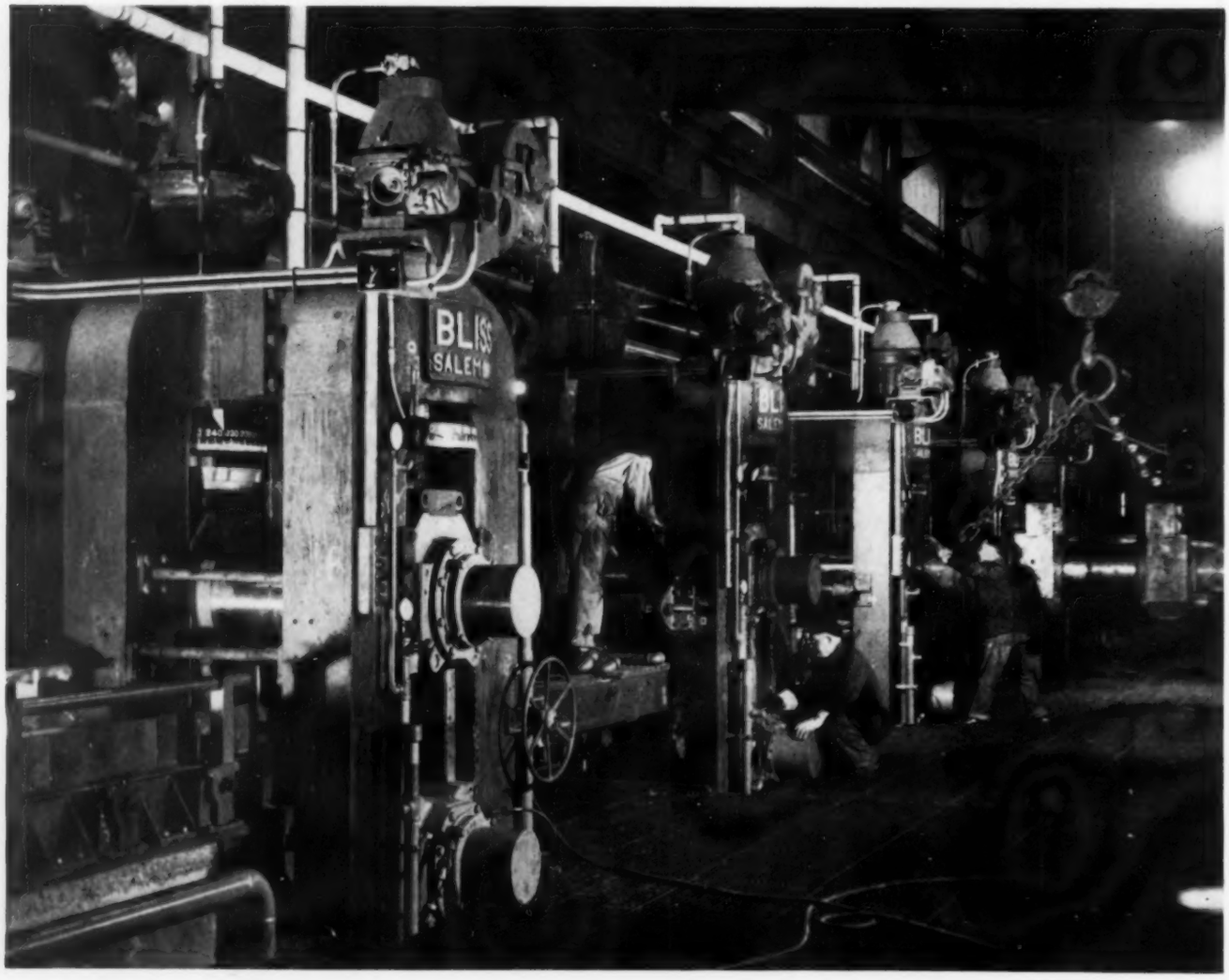
▲ This month should see the first rolling on the new 20 in. continuous hot strip mill being erected at Superior Steel Corp., Carnegie, Pa., to replace two older mills, according to E. J. Reardon, operating vice president. The new mill is being installed to further improve surface finish and to improve the structure by additional hot working. Its product will include stainless steel strip in widths from 4 in. to 18 in. in thicknesses as light as .065 in. and carbon steel and clad metal strip in widths from 4 in. to 20 in. in thicknesses down to .040.

The mill is installed in the existing building which housed two older 10 in. and 14 in. looping strip mills. The installation includes a 3-high roughing stand, upcut shear, five 4-high finishing stands, collapsing mandrel type coiler, continuous overhead coil conveyor, and auxiliary roller tables, cooling tables, and cranes.

The roughing stand is a 3-high 29 in. x 40 in. universal stand driven through a 2.3:1 reducer by a 2000

Stand	Motor hp	Motor voltage	Gear ratio	Roll rpm	Strip speed fpm
1	1500	2300 a-c	2.84:1	90.5	332
2	1500	2300 a-c	2.42:1	149	545
3	2000	600 d-c	Direct	200-360	668-1200
4	1500	600 d-c	Direct	325-450	1085-1500
5	1500	600 a-c	Direct	300-600	1000-2000

Workmen install a back-up roll in one of the 5 tandem finishing stands of Superior's modern 20 in. hot strip mill, scheduled for completion in January. Mill will roll stainless, clad, alloy and carbon steels at speeds up to 23 mph, with improved structure and surface quality.



hp, 180 rpm, 2200 volt synchronous motor. Rolls in the roughing stand run in composition roll neck bearings, and the screwdowns are driven by two 25 hp motors through 12⅔:1 reducers.

Vertical edging rolls are located on the entry side of the mill and are driven by a 300 hp, 600 volt d-c motor which is supplied by a 400 kw, 600 volt generator driven by a 500 hp, 2300 volt synchronous motor.

Tilting tables on both sides of the mill manipulate the slabs between passes.

A 2500 psi, 270 gpm descaling spray system is installed at the roughing stand.

Heating facilities for the mill consist of two previously used continuous slab heating furnaces 50 and 55 ft long and respectively triple and double fired. The furnaces are capable of handling 10 ft slabs which are advanced through the furnaces by hydraulic pushers.

An upcut shear, located 93 ft-6 in. from the roughing stand is capable of front end cropping of hot material 1¼ in. thick by 20 in. wide.

Located 128 ft-6 in. from the roughing stand is the first of five finishing stands arranged in tandem on 15 ft centers. Work rolls in the first two stands are 14 in. in diameter, while the work rolls in the last three stands are 12¾ in. in diameter. All back-up rolls are 24⅞ in. in diameter. Roll face length is 24 in. Oil flooded bearings are applied on the back-up rolls, and roller bearings are used on the work rolls. Screwdowns are driven by 7½ hp motors through 500:1 reduction.

The following motor and speed data apply on the finishing stands.

The d-c motors are supplied by a double 1250 kw 600 volt d-c generator set up driven by a 3800 hp 2300 volt synchronous motor.

A driven collapsing mandrel type coiler is located at the end of a 170 ft-6 in. watersprayed runout table. The mandrel of this coiler is 20 in. in diameter and is capable of handling a width range of 4 in. to 20 in. strip ranging in thickness from .060 in. to 200 in. Eight guide rolls 8 in. in diameter, in sets of two, operate radially with respect to the coiler to wrap the coil. Coils 40 in. in diameter can be made on the coiler. The coiler is driven by a 40 hp, 220 volt d-c motor.

The coils are stripped from the collapsed mandrel into a coil-transfer carriage which retains the coils in a vertical position and places them on hooks of a continuous, overhead; coil conveyor which moves to a newly provided stockhouse.

The stockhouse which is 258 ft x 86 ft is serviced by a unique system of cranes. Four crane bridges, two to a runway, can be utilized one or two at a time in either runway by only two cab hoists. Transfer points at one end of the building permit cab hoist transfer from bay to bay and bridge to bridge.

The mill, located in a building 495 ft long x 80 ft provides rolling capacity of 10,000 tons per month of strip ranging from 4 in. to 20 in. in width and from .060 in. to .200 in. thick in the case of carbon steels and clad metals; the range of sizes for stainless steels is 4 in. to 18 in. in width and .065 in. to .200 in. thick. Slabs used will vary in thickness from 3 in. to 6 in.

REFRACTORIES STUDIED BY GRADUATE STUDENTS AT UNIVERSITIES

▲ In the interest of furthering the training of technologists for the refractories industry, the American Refractories Institute has sponsored fellowships for worthy graduate students who are interested in the study of problems relating to refractory materials. Eight fellowships on refractories have been established at universities having ceramic departments, and a brief outline of the work which is being done by these men is as follows:

Richard L. Allen, of the research foundation at Ohio State University, is investigating the influence of very high forming pressures on the porosity, density, and strength of refractory compositions containing high percentages of coarse non-plastic materials.

Henry C. Brassfield, at the Missouri School of Mines and Metallurgy, is studying the behavior of titanium dioxide on silica brick during burning, as a catalyzer, to convert quartz to cristobalite and tridymite. X-ray spectrometer data on fired samples, as well as those obtained during heating, are to be used to evaluate the extent of the conversion.

William E. Brown, in the School of Ceramics at Rutgers University, is engaged in learning of the part played by alkalies on the refractoriness of siliceous fireclay brick. Use is to be made of the hot load test to study the effect of these fluxes when added to alkali-free mixes.

William D. Fitzpatrick, in the ceramic engineering department of the University of Illinois, is conducting an investigation on some of the effects of the glass phase present in certain refractory compositions.

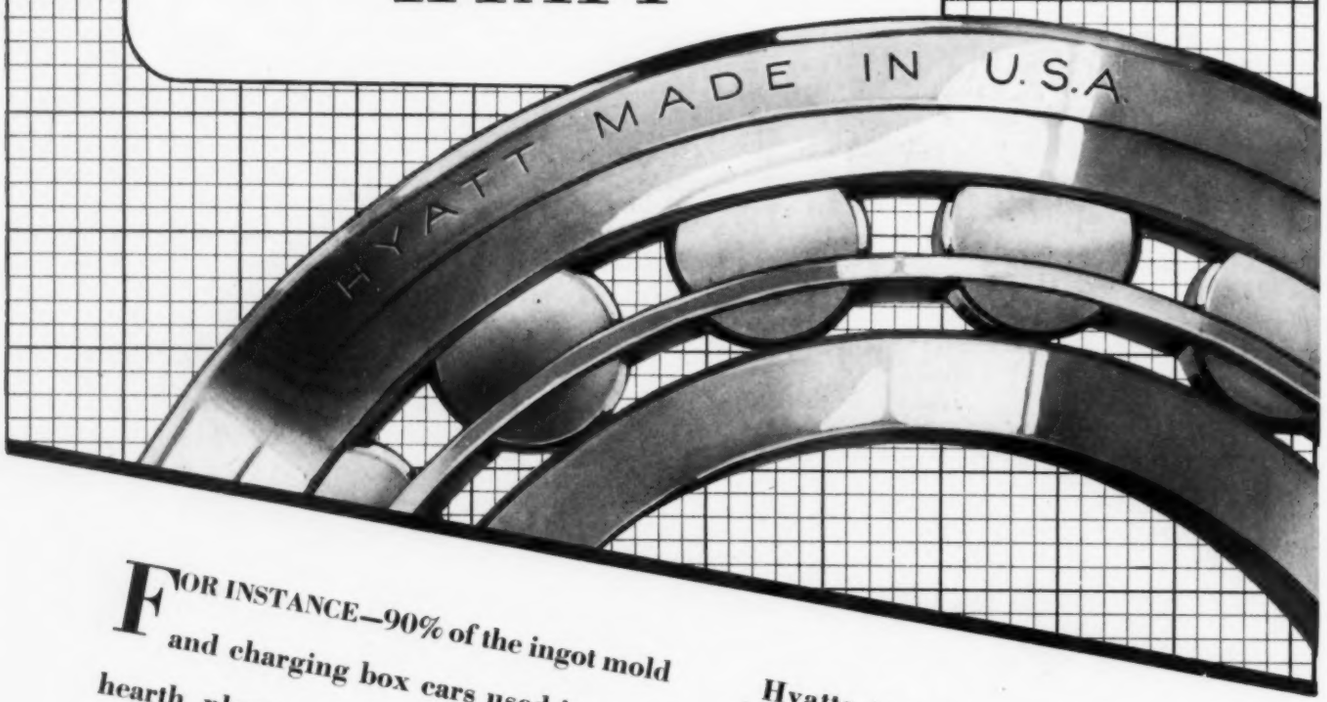
J. Raymond Hensler, in the division of ceramics at Pennsylvania State College, has been engaged in the study of electrical resistance of refractories at elevated temperatures. Later he expects to measure this property, up to practical temperature limitations, on commercial and laboratory-prepared refractories, the maximum temperature of the equipment to be of the order of 3600 F.

William D. Kingery, of Massachusetts Institute of Technology, is investigating certain orthophosphate cements for use in refractory compositions by studying the mechanism of setting, their bonding properties, and the effect of heat on their stability. Later, an attempt will be made to correlate the setting action with atomic structure.

Robert A. Morgan has studied in the division of ceramics at Pennsylvania State College certain phase relations of the system beryllia-alumina-silica which are of interest to ceramists and metallurgists, the results of which are being prepared for publication.

Hugh H. Wilson, Jr., in the department of engineering research of North Carolina State College, is determining the hot load-bearing characteristics of silica-clay refractory compositions made from selected raw materials prepared with controlled grain sizes.

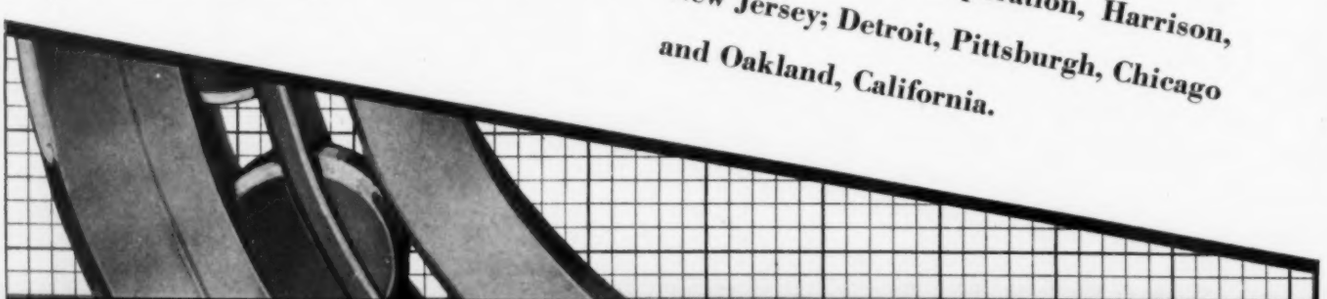
Steel men prefer bearings made by HYATT



FOR INSTANCE—90% of the ingot mold and charging box cars used in open hearth plants operate on Hyatt Roller Bearings.

Because—maintenance is simplified—wear is reduced—axle breakage virtually eliminated—more cars per locomotive can be hauled faster.

Hyatts too are preferred for table, crane and motor applications throughout the mills. That's why so many of them are used for changeovers and specified for new equipment. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey; Detroit, Pittsburgh, Chicago and Oakland, California.



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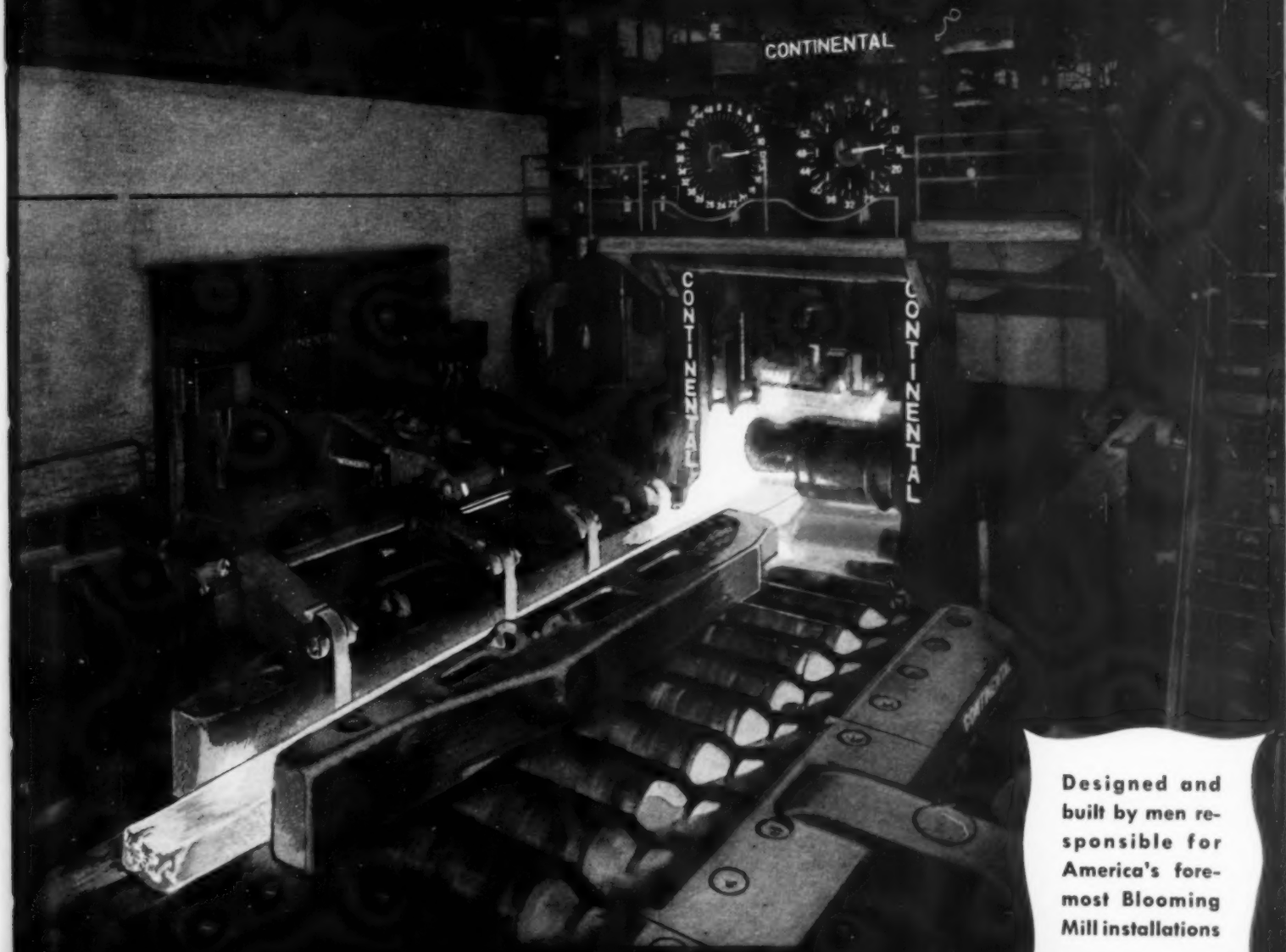

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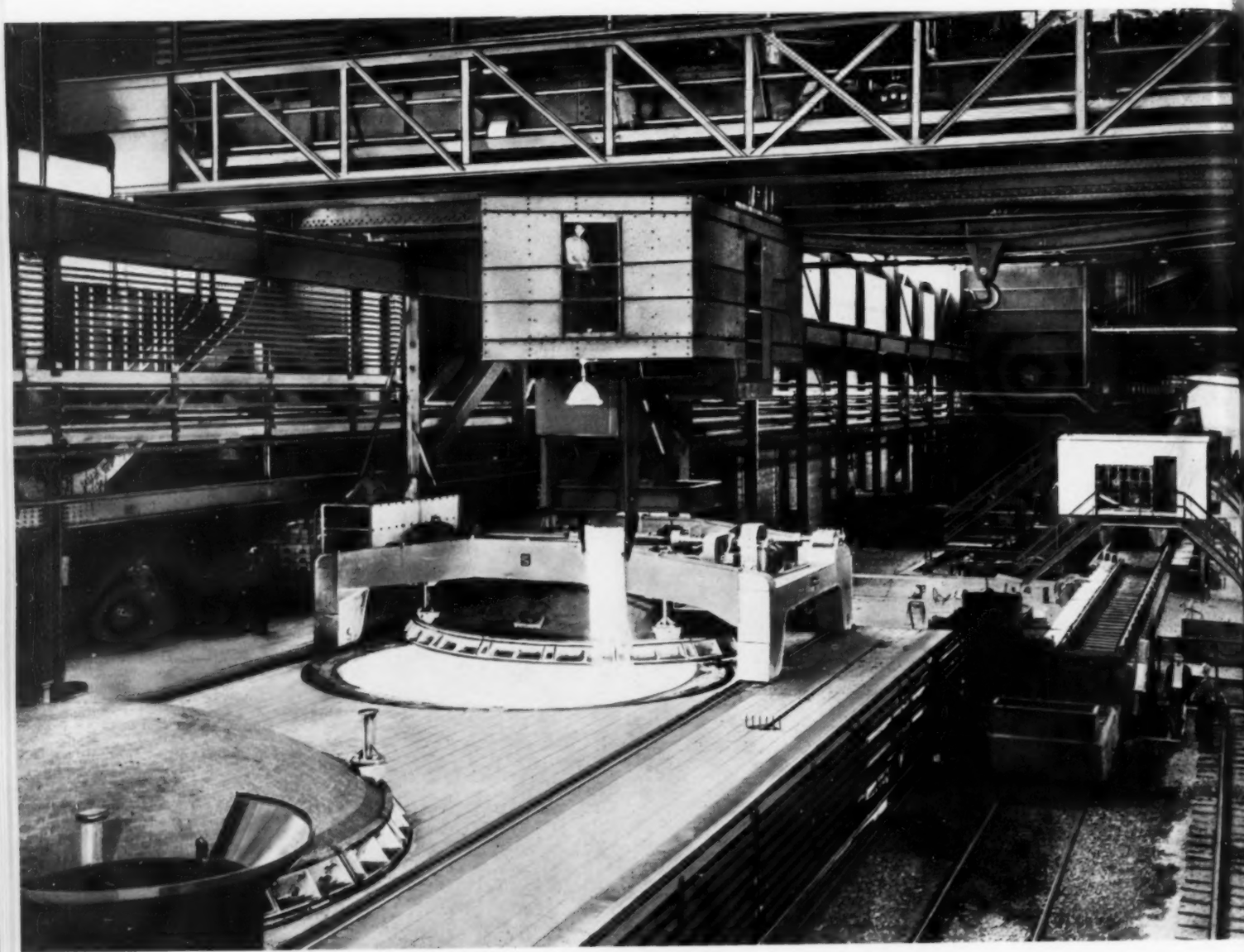
BUILT BY MORGAN Engineering

MORGAN 7½-TON, 81′3″ SPAN SOAKING PIT CRANE



Illustrated is a Morgan 7½-Ton, 6-Motor, 81′3″ Span, Stiff Leg Type Soaking Pit Crane. It serves a Morgan 36″ Two-High Blooming Mill which was furnished complete with auxiliary equipment. It is equipped with fabricated welded trolley and bridge trucks. Morgan Pit Cranes are provided with spur or worm gear operated trolleys and sleeve or anti-friction bearings as required.

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Industry News...

CURRENT EXPANSION AT JONES & LAUGHLIN IS LARGEST IN ITS 97-YEAR HISTORY

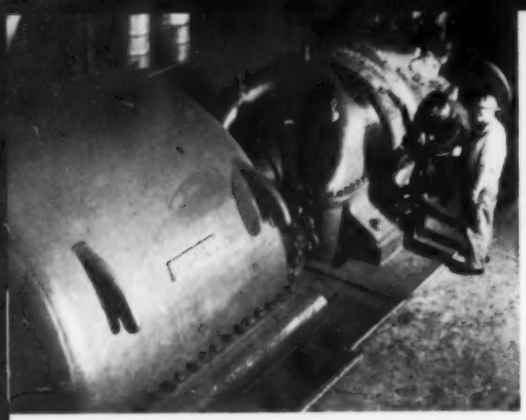
▲ The post-war plant improvement program of Jones & Laughlin Steel Corp. is the largest in its 97-year history. Every phase of steel production from ore mines through finishing mills is affected by the program which now provides for estimated expenditures totaling more than $210,000,000. The corporation is spending on improvements and rehabilitation in this post-war program an amount equal to two-thirds of the corporation's gross plant value at the end of the war.

Major phases of the program to be undertaken or completed next year are:

1. Completion of the world's largest coal washer at Vestaburg, Pa. Consolidation of Vesta No. 4 and Vesta No. 5 mines into the largest underground coal mine in the world.
2. Construction of a new six-furnace open hearth shop in Pittsburgh, Pa., and the necessary corollary and finishing facilities at Pittsburgh and Aliquippa, Pa., works;
3. Construction of a new central boiler plant at South Side, Pittsburgh works, to replace five obsolete plants, is nearing completion. Two of the new boilers are operating and three more will be completed early in 1949.
4. The enlarging of No. 5 blast furnace at Pittsburgh has been started and will be completed in January, 1949. Installation of two additional turbo blowers at the blast furnaces is under way. One is in operation and the other will be in operation early in 1949.
5. An additional bessemer converter—bringing the total at Pittsburgh to three—is under construction and will be in production by the middle of 1949.
6. A program to expand and improve the hot and cold strip mill at the Pittsburgh works, has been started with the rebuilding and improving of slab-heating furnaces. The program includes installation of a new hot coil conveyor system, and additional cold finishing facilities.
7. Three five-hole blocks of soaking pits have been authorized for Pittsburgh works. One block will be completed during 1949. Sixty 100-ton slab rack cars to handle hot steel are being installed.
8. No. 1 blast furnace at Otis works will be enlarged and relined during 1949. A new turbo blower will be installed. Hot strip-sheet and cold rolling facilities will be modernized and expanded.
9. Major expenditures are under way at the corporation's ore mines in Minnesota, New York, and Michigan.

Part of the program is already completed and becoming effective. During 1948 the world's fastest rolling mill for cold reducing tin plate coils went into production at Aliquippa works. One of the world's largest batteries of coke ovens went into production at the Aliquippa works, and by-product facilities are being rehabilitated and enlarged. This was the second battery of this size to go into operation at Aliquippa in the past three years. New hot metal cars were installed and reladling pits built to

Construction of six open hearth furnaces, a short distance from the Pittsburgh, (Pa.) Golden Triangle business district, is planned by Jones & Laughlin Steel Corp. Location of the open hearth shop as part of J&L's South Side works is shown here. Together with the availability of additional iron resulting from blast furnace and raw material improvements, construction of these furnaces will result in a net increase of total ingot capacity at Pittsburgh works amounting to over 400,000 tons annually. Estimated cost of the project including necessary corollary and finishing facilities at Pittsburgh and Aliquippa (Pa.) is $70,000,000.



This new turbo blower is one of two under construction at the Pittsburgh works, Jones & Laughlin Steel Corp., to improve blast furnace production of iron. In addition, one of the five blast furnaces at Pittsburgh is now being enlarged.

replace existing hot metal mixers for open hearth and bessemer plants at Aliquippa. Extensive improvements were made in wire producing facilities.

At Pittsburgh works during the past year, an additional boiler was added to the power plant on the north side of the Monongahela River, extensive changes were made in the 28-in. billet mill for improved product, one battery of coke ovens was rehabilitated, a new skull breaker was installed, and a new warehouse for cold finished steel was built.

At Otis works, a new open hearth furnace of the most modern design was added during the past year.

At the wire rope division, Muncy, Pa., expansion of warehouse and production facilities was completed.

Warehouse expansion and other improvements were completed at the electric weld tube division, Oil City, Pa.

New facilities were completed during the past year at Benson Mines, Star Lake, N. Y., including a pilot plant for separation of non-magnetic iron ore from crushed ore-bearing rock.

Iron is shown here as it is poured into the new open hearth furnace built during 1948 at Jones & Laughlin Steel Corp.'s Otis works, Cleveland, Ohio.

LEWIS FOUNDRY RECEIVES TWO EXPORT CONTRACTS

▲ Lewis Foundry & Machine division of Blaw-Knox Co. has received two contracts for rolling mill machinery for export shipment.

The South African Iron & Steel Industrial Corp., Ltd., placed an order with Lewis for the engineering and construction of a complete rod mill to be located at Pretoria, Union of South Africa. This installation will consist of a 20-stand mill and auxiliary equipment to roll No. 5 rod.

The other contract is from the Argentine government and calls for a rolling mill plant equipped to roll aluminum, brass and copper. This order, which covers two mill units and auxiliary equipment, was placed by Direccion General de Fabricaciones Militares, and the plant will be located at Buenos Aires.

The two contracts amount to approximately $2,000,000.

FRENCH NEGOTIATING FOR ECA STEEL PLANTS

▲ A $50 million steel rolling mill to be purchased in this country by Sollac, a French company, and financed by Economic Cooperation Administration funds, is now being negotiated by the French government and ECA officials.

The electrical equipment for the projected steel mill will cost about $15 million.

Plans call for the rolling mill to be erected at Hayange and Ebange, France. It will include a blooming mill, a ten-stand hot strip mill, a five-stand tandem cold mill and a three-stand tandem cold strip mill. Sollac is a newly-organized company which was formed by eight existing French steel companies.

It was also disclosed that a blooming mill, costing about $7 million, is now being built at Rombas, France, by the Rombas Steel Co. It is being privately financed. The contract was signed last August. United Engineering & Foundry Co. of Pittsburgh is constructing the mill and Westinghouse Electric Corp. is supplying the electrical equipment, which represents about a third of the mill's total cost.

Westinghouse is also providing the electrical equipment for a $27 million rolling mill, including a blooming and hot and cold strip mills, being built by Usinor, an operating company formed by two French companies, Demain-Anzin and Nord L 'Est. The contract for this mill was let in April, 1947, and the project is being financed by the ECA. United Engineering also is constructing this mill. The hot mill is being installed in northeast France and the cold mill north of Paris.

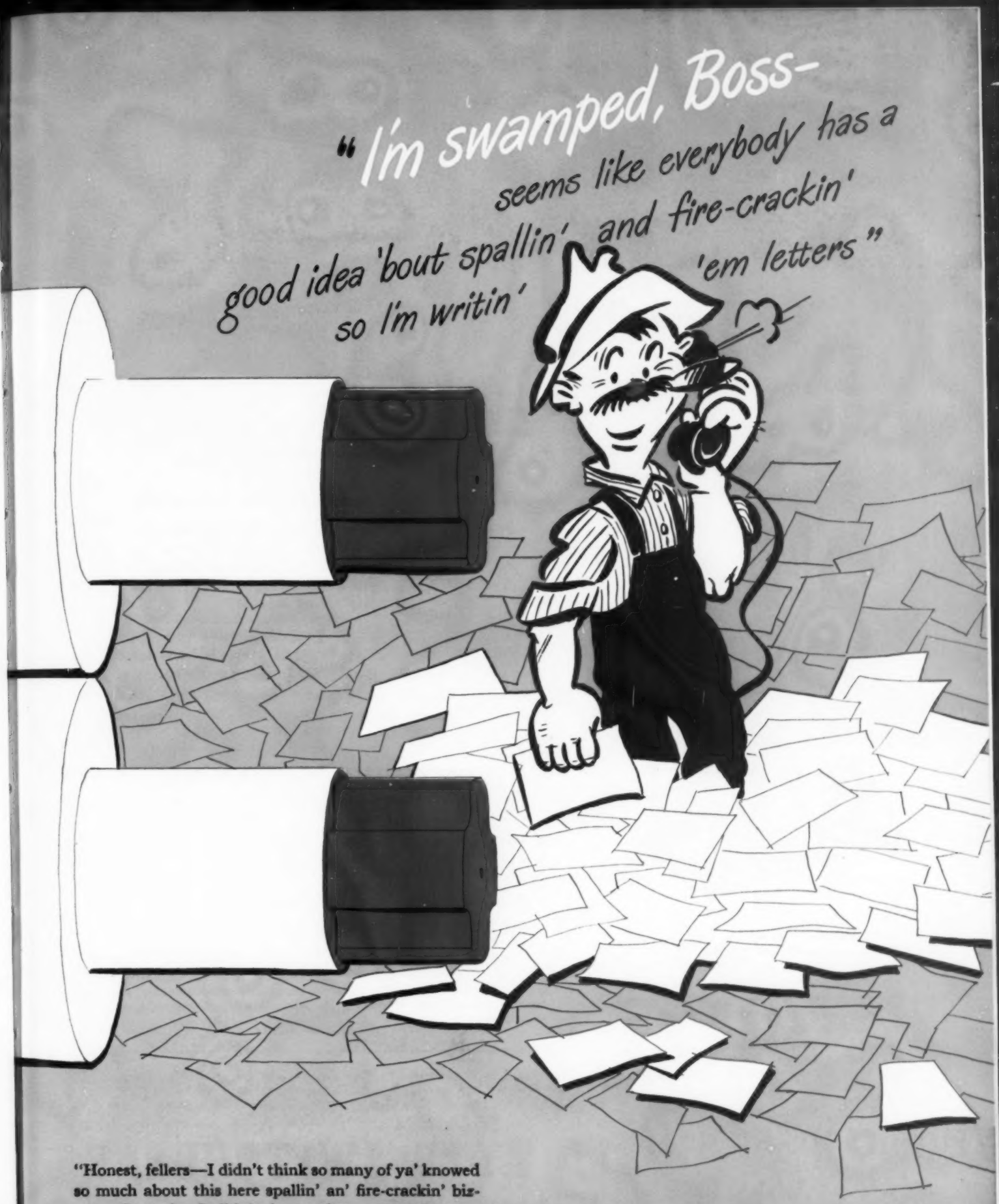
The Westinghouse officials said that France's present steel capacity is about 8 million tons per year, although it could not produce at full capacity this year because of the coal shortage. They added that France hopes to increase her steel capacity to about 12 million tons per year.

COMPLEX WASTE PROBLEM IS HANDLED EFFICIENTLY

▲ An example of efficient handling of a complex waste disposal problem is the plant-wide program currently underway at the Jeannette, Pa., plant of Elliott Company, producers of turbines, condensers, superchargers, centrifugal blowers and other plant and processing equipment. The contaminants that required disposal are several—all common to such operations. They include soluble and lubricating oils, waste pickle liquor and rinse water, and cyaniding quench waters.

First offender dealt with by Hall Laboratories in the program, which is now nearing completion, was soluble and lubricating oils. It was determined that these oils—mainly from compressors, steam turbines, and the gear boxes of production machine tools, and spoiled coolants used by production and precision machine tools—were being permitted by shop workers to pass into floor drains leading to the plant sewers. Accordingly, drip receivers were installed, and the oily waste thus collected now is dumped on the coal stockpile. A skim baffle was installed on the spray pond. A third step was the shaping of an earthen basin at the sewer outfall to act as an oil trap in case of accidental oil spills. Finally, provision was made in the plant maintenance work schedule for separate collection of waste soluble oils and disposal of this material on the coal stockpile.

Waste pickle liquors are neutral-



"Honest, fellers—I didn't think so many of ya' knowed so much about this here spallin' an' fire-crackin' bizness. Gee wiz, I didn't know there were so many causes. My Boss says he'll help me pick the champs, an' it's gonna' be a tough job.

"It looks to me like the Ol' Man's gonna have to buy several hats and shirts. Here's hopin' you're one a' them whizzin' winnahs."

Ol' Red

MACKINTOSH-HEMPHILL CO.

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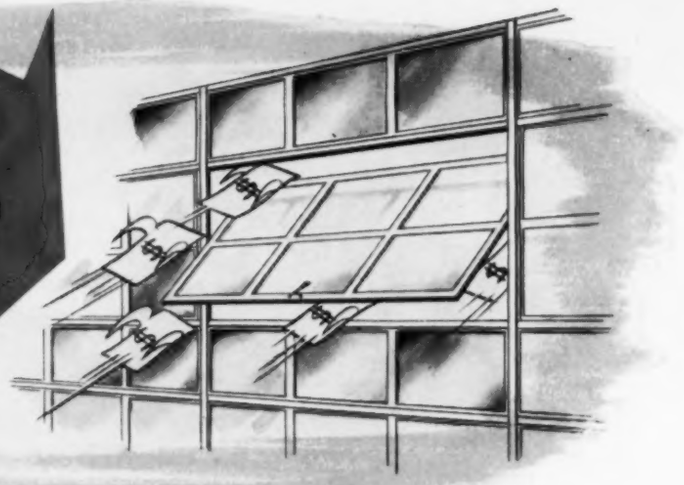
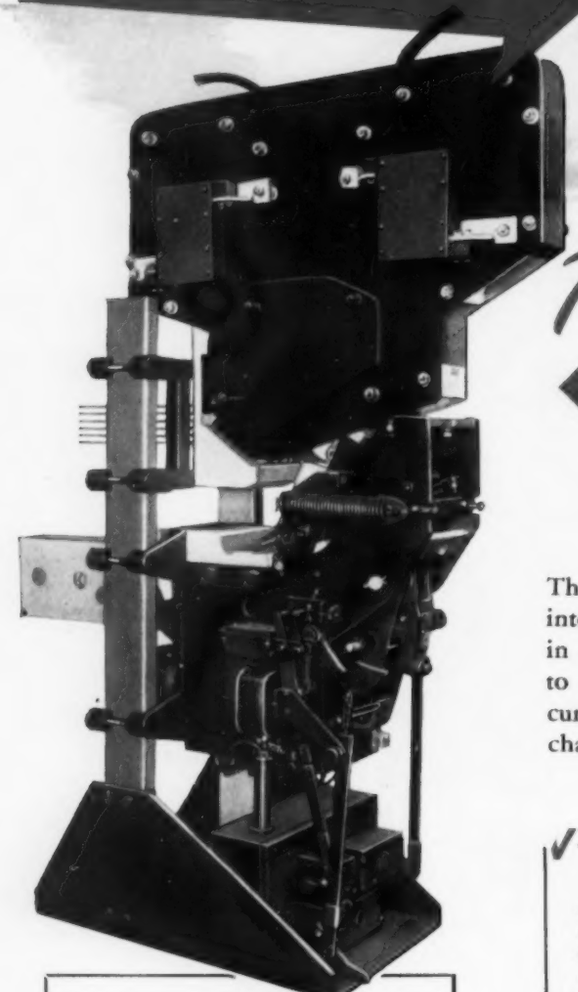
How much would a shut-down cost you?





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with this better-designed, better-built breaker

Efficient production is a complete chain of operation. Obsolete electrical switchgear may be the weak link that can shut down your plant. Protect your production more effectively, more dependably, with I-T-E's Type MT Automatic Reclosing Circuit Breaker.

The MT is a rugged, effective breaker, specially developed for interrupting extremely heavy direct-currents. It breaks a circuit in .028 seconds (about 1¾ cycles on a 60-cycle basis) at 25% to 100% of interrupting capacity. Short circuits and overcurrents are cleared instantly, completely—before they have a chance to spread trouble.

TYPE MT

Single pole . . . Electrically operated . . . Application Ranges: 250 and 750 V. D-C. Interrupting rating is 150,000 Amp. in capacities of 2000 and 4000 continuous ampere ratings . . . 250,000 Amp. in capacities 6000 Amps. continuous and above.

Further information on the I-T-E Type MT is contained in catalog 2202. Send for it today.

NOTE THESE MT FEATURES

✓ **RATE-OF-CURRENT-RISE TRIP**

Anticipates extremely high currents . . . Distinguishes between useful load of high value and a dangerous fault current . . . Trips breaker before danger peak is reached.

✓ **TRIPPING DEVICES**

The MT is electrically and mechanically trip-free on overcurrent—trips immediately when closed on a fault . . . All tripping devices are direct-acting and instantaneous.

✓ **BUFFER MECHANISM**

A specially designed, self-energizing buffer mechanism smoothly absorbs shocks of opening—prevents sticking or bouncing.

✓ **MOUNTINGS**

Normally built in two styles: for pedestal mounting and for panel mounting. Also drawout-truck mounted in metal-clad switchgear.

The I-T-E Representative in your locality will be glad to advise you on applying the MT—and other I-T-E protective equipment—to your electrical distribution system. Use his services without obligation.

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MILL TYPE SWITCHGEAR

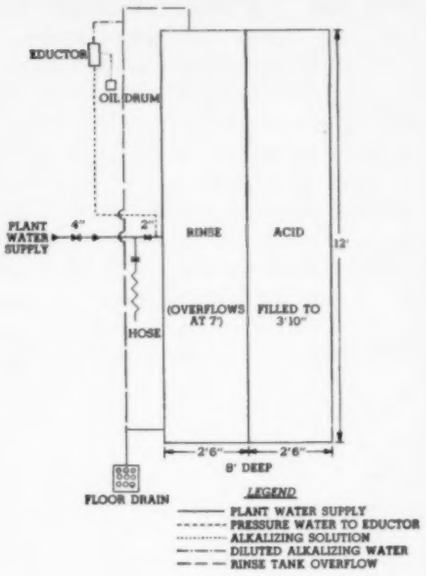
The Leader In Technical Excellence

I-T-E CIRCUIT BREAKER CO. — 19th & HAMILTON STS., PHILA. 30, PA. — 31 OFFICES IN THE U. S. & CANADA

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • AUTOMATIC RECLOSING CIRCUIT BREAKERS • HIGH SPEED CIRCUIT BREAKERS

**FOR POWER SWITCHING EQUIPMENT REFER TO RAILWAY AND INDUSTRIAL ENGINEERING CO. AN I-T-E SUBSIDIARY*

SCHEMATIC DIAGRAM OF ALKALI FEED



Alkali is automatically fed to neutralize acid drag-out.

ized in the pickle tank by periodic addition of alkali, with sludge disposal in a lagoon on plant property near by.

Two underground oil storage tanks, no longer used for their original purpose because of a recent change in fuel, made possible the economical disposal of rinse water. The water is automatically neutralized during operation, and piped to the tanks. One tank has been adapted for sedimentation and withdrawal of neutralized rinse water through a swing pipe; the other tank is used for concentration and storage of sludge produced by the neutralization of the rinse water. Each morning the swing pipe skims off the supernatant (clear liquid) which then is disposed of in the plant sewerage system.

To accomplish neutralization of rinse water, a branch line was installed between the inlet valve and the tank. An eductor is in this branch line, which feeds alkali to the rinse tank discharge. Thus whenever the inlet valve of the rinse tank is open, alkali is automatically fed to neutralize acid drag-out.

Care in rinsing and segregation of cyanide rinse water, and separate disposal, proved to be a different problem but not costly or difficult. Formerly, small parts of turbine governors were dipped in cyanide salt baths, and quenched with continuous runover. Normal volume of this operation was about 200 pieces per month. When it was found that the contin-

Only Wing Revolving Heaters Circulate the Heated Air Around Obstructions

AS the air from roof or ceiling areas is passed through the heating element of a Wing Revolving Unit Heater and projected downward through discharge outlets that slowly revolve, the heated air is not delivered to the working area in single-direction blasts, but in moving air-streams that sweep slowly through 360 degrees, covering successively every direction. The heated air moves around and under obstructions reaching to walls and remote corners. Every part of the plant is thus kept at an invigorating comfortable temperature.

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UNIT HEATERS

uous overflow was contaminating the main body of plant waste water (which averages about 300 gpm) it was decided to switch from continuous rinse to batch rinse. This in turn made possible the minimization and segregation of this noxious waste, with separate disposal. Total waste thus disposed of averages about five gallons per day, six days per month.

Finally, it was determined that sodium dichromate, which was formerly employed to prevent corrosion in cooling water circuits on the Elliott dynamometer stands, was having a toxic effect on the plant waste water. Accordingly a non-toxic material, Calgon—a special phosphate glass—was substituted.

SHEET GALVANIZING LINE ROLLS 300 TONS PER DAY

▲Heavy galvanizer sheets are now rolling from a new continuous-coating galvanizing line at Irvin works of Carnegie-Illinois Steel Corp. at a rate of 300 tons a day. A similar line for production of light gage material will be in operation at this U. S. Steel plant in a few months.

The new line turns out a product of far better quality than the old type hand sheet galvanizing method and at the same time automatically eliminates the need for further processes such as box annealing, sheet pickling and hand feeding.

The continuous method produces a more adherent coating, which will not flake or break in forming or bending of the sheets. This is a quality which could be realized only with difficulty by the old hand production method. Under the new method, the coating of zinc is more uniform too, and the thickness of the coat can be regulated more readily for special purposes.

Sheets from the new heavy galvanizing line go principally into railroad car roofing, culvert and drainage structures, storage tanks, heavy drums and railroad refrigerators.

The heavy gage line is constructed to coat steel strip 20 to 54 in. wide and 11 to 18 gage in thickness. It operates at a speed of 8 to 120 fpm and averages 300 tons of products in a 24-hour run. Coils of cold reduced steel up to a maximum of 50,000 lb are fed into the line, keeping it in continuous operation.

GOULD OPERATES SCHOOLS FOR BETTER MAINTENANCE

▲A series of practical one-week "schools" to teach better techniques of storage battery maintenance and repair to foremen, supervisors and engineers in those many industries which employ lead-acid batteries for motive power, standby or direct current supply, was inaugurated in Trenton, New Jersey, by Gould Storage Battery Corporation, November 8 to 12. Ten representatives from five of the largest coal mining enterprises in the United States heard nine lectures, tackled three do-it-with-your-own-hands laboratory projects, witnessed two major demonstrations, stood both written and oral examinations, and received diplomas, during five full days of this first Gould industrial storage battery school.

So successful was this course for coal men (concerned with underground haulage costs) that future five-day schools will definitely be conducted by Gould for additional industrial groups, as well as for classes interested in (1) battery-powered lift trucks and material handling systems, (2) telephone and other communications sys-

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RUST PROOFING AND PAINT BONDING
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"RODINE" saves acid and metal—minimizes embrittlement — improves pickling. For smooth and bright pickled surfaces, specify "RODINE".

ACP extends season's greetings to the steel industry.

Pioneering Research and Development Since 1914
AMERICAN CHEMICAL PAINT COMPANY
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tems, (3) railway car lighting, diesel starting and air conditioning, and (4) transportation signal work. The next school will likely be held in about 90 days and will probably be organized specifically to help industrial truck users. Interested applicants should write to James A. Gilruth, Gould Storage Battery Corporation, Trenton, New Jersey, for particulars.

AMERICAN FLEXIBLE APPOINTS EHRET & KINSEY

▲ The appointment of the firm of Ehret & Kinsey, Chicago, as sales engineers, was announced recently by Everett F. Zurn, president, American Flexible Coupling Co., Erie, Pa. This organization has had many years' experience in the application, specification and sales of flexible couplings and other mechanical equipment. Ehret and Kinsey are located at 327 So. LaSalle, Chicago 4, Ill. Phone: Wabash 2-4146 and 2-4147.

WORTHINGTON ABSORBS SUBSIDIARY FIRM

▲ Worthington Pump & Machinery Corp. announced that as of November 29, 1948, the manufacturing and distributing activities of its subsidiary, Ransome Machinery Co., would be conducted by the parent corporation.

RYERSON ADDS TO WAREHOUSE FACILITIES

▲ Joseph T. Ryerson & Son, Inc., pioneer Chicago steel firm, has begun construction of a large brick and steel addition to their Chicago plant which will provide approximately 118,000 square feet of modern plant and office space. Completion is scheduled for November, 1949. This is the initial move in a series of planned additions and improvements which, according to President Everett D. Graff, will ultimately result in large-scale expansion and modernization of their entire Chicago property. The company operates what is known as a steel-service business, supplying bars, plates, structurals, sheets, strip, tubing and other steels from stock. In recent years alloy and stainless steels have become important products. Their Chicago plant is said to be the largest of its kind in the world.

The new building, an L-shaped structure, will be erected at 15th and Rockwell Sts., becoming a part of what is known as the north unit of their three block plant, and extending east along 15th St. from Rockwell St. to the Pennsylvania Railroad, a distance of 470 ft. Construction includes a two-story office building, an integral part of the plant addition, which forms part of the new structure of 200 ft on Rockwell St., and which will provide about 12,000 sq. ft. of office space.

This new building will add 118,000 sq ft to Ryerson facilities in Chicago, Ill.

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INSTRUMENTS AND CONTROLS FOR EVERY NEED

TO IMPROVE PRACTICALLY ANY PHASE OF STEEL PROCESSING, TO CUT FUEL AND LABOR COSTS

The bulletin illustrated is not just a piece of sales literature but a complete 24 page treatise on the instrumentation and automatic control of steel making and heat treating furnaces. You'll want a copy for your reference files, want to profit from its practical, authoritative information.

And remember as you read it, Hays engineers are thoroughly qualified and ready to work hand-in-hand with you in solving your own specific instrumentation and control problems . . . without obligation.

Write for your copy today . . . Ask for Bulletin No. 48-750 (covering heat-treating furnaces). Companion edition covering open-hearth furnaces will also be included.

Steel that's better, with more uniform grain structure . . . maximum production because of continuous equipment performance . . . fewer rejects . . . lower fuel, maintenance and labor costs—these are advantages you can count on when you use Hays instruments and controls for:

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Heat treating
Melting
Nitriting
Normalizing
Tempering
Welding

For indicating and controlling:
Pressure
Flow
Furnace Draft
Fuel air-ratio
Gas analysis

Inquiries invited on any of these specific applications.

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Since 1901 COMBUSTION & INDUSTRIAL INSTRUMENTS & CONTROL
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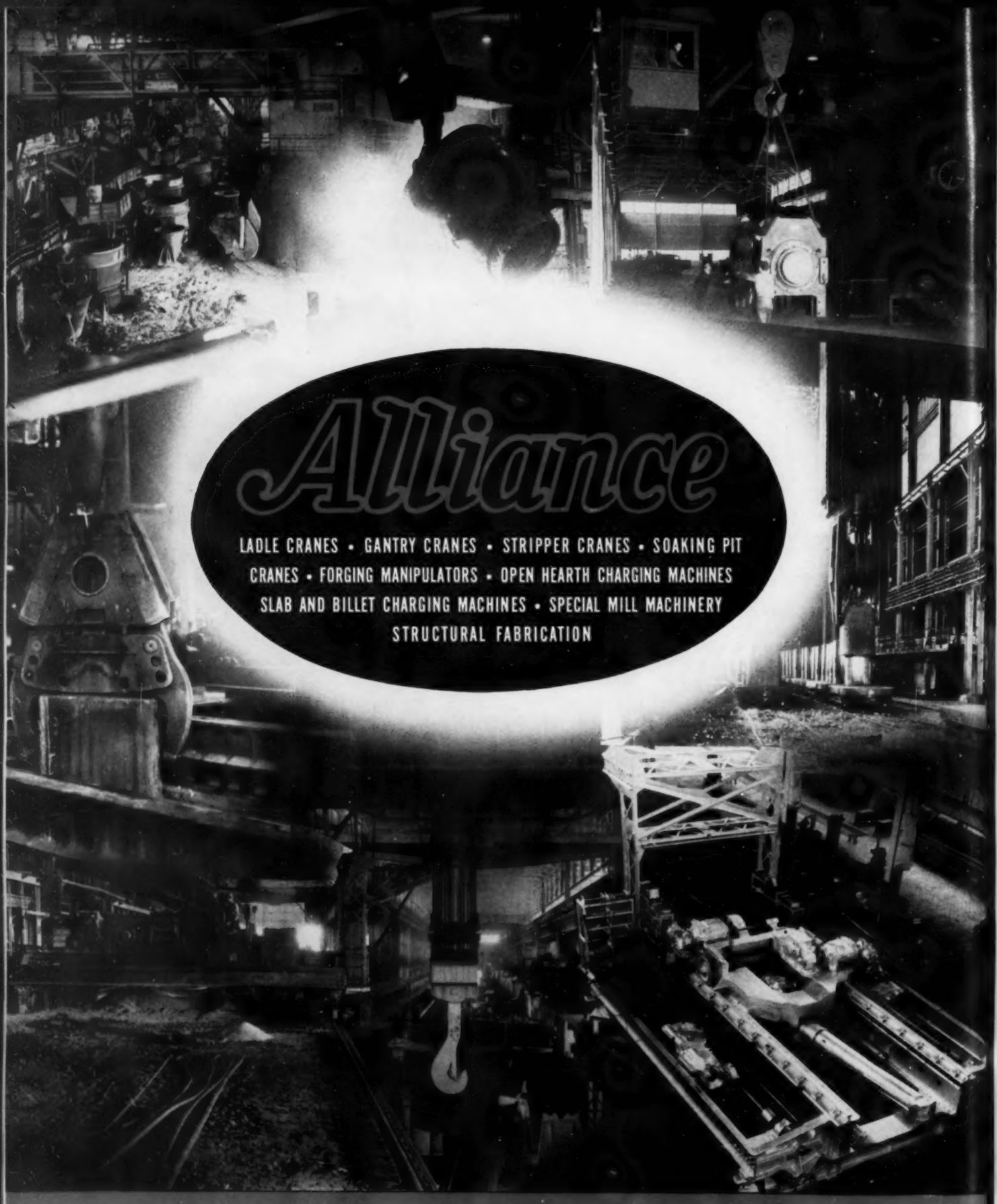
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LADLE CRANES • GANTRY CRANES • STRIPPER CRANES • SOAKING PIT CRANES • FORGING MANIPULATORS • OPEN HEARTH CHARGING MACHINES
SLAB AND BILLET CHARGING MACHINES • SPECIAL MILL MACHINERY
STRUCTURAL FABRICATION

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1622 OLIVER BLDG., PITTSBURGH, PA.

CHAIN BELT OPENS ATLANTA WAREHOUSE

▲ Chain Belt Co., of Milwaukee, announces the establishment of a new Atlanta warehouse, at 878 Ashby St., N. W., Atlanta, Ga. The new Atlanta warehouse will serve the entire southeast, including the states of North Carolina, South Carolina, Virginia, Georgia, Florida, and Alabama. A 24-hr delivery service will be available to most parts of the territory served. This warehouse will be used to give better service to Chain Belt Co. customers and to aid Rex and Baldwin-Rex Distributors in serving their customers faster and with a more complete, readily available, line of Chain Belt Co. products.

SCREW AGREEMENT AIDS INTERCHANGEABILITY

Secretary of Commerce Charles Sawyer (right) and William L. Batt, president of SKF Industries, Inc., compare a couple of bolts and nuts to celebrate the signing of an international treaty unifying the screw threads of Britain, Canada and the U. S. at the National Bureau of Standards in Washington. The agreement, which permits the interchangeability of thousands of machine parts, was brought about by a committee of American, British and Canadian technical experts.

KOPPERS USE STAINLESS STEEL IN DAM GATES

▲ Twenty-six gates, each weighing 35 tons and sheathed in stainless steel, will be built by the Metal Products division of Koppers Co., Inc., for the new Conemaugh River Dam in Western Pennsylvania. The contract to Koppers was awarded by the U. S. Army Engineers, and provides for delivery in 360 days. Cost of the gates will be $1,237,000.

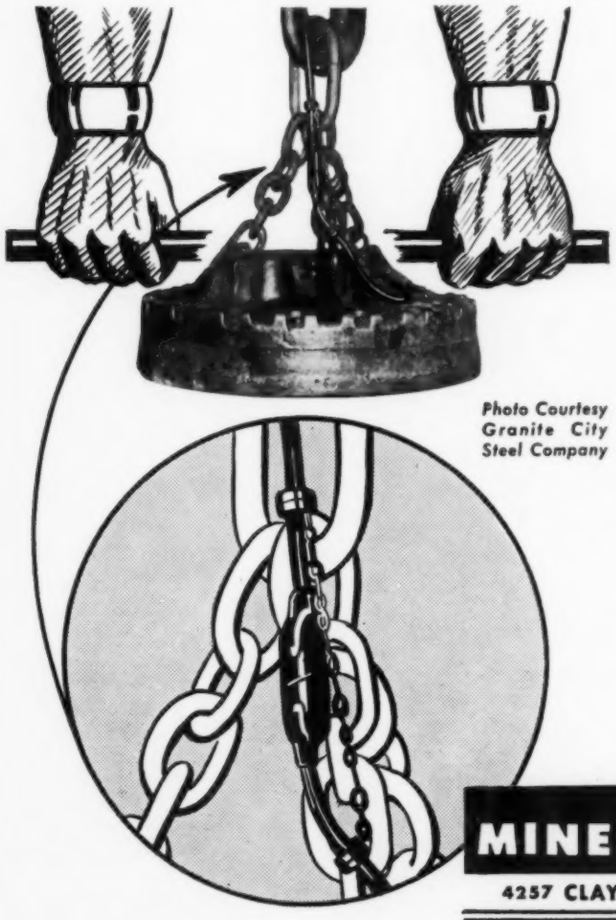

Photo Courtesy Granite City Steel Company

Insuring This

GIANT'S GRIP...

caused grave concern at Granite City Steel Company, Granite City, Illinois plant until MINES Molded "Neoprene" rubber connectors were used to connect the magnet to its power cable (see illus.).

MINES Connectors were chosen because investigation proved them immune to conditions that caused other units to fail after short usage. 1st, MINES Connectors can't be accidentally disengaged. 2nd, MINES Connectors seal themselves against outside conditions when connected. This eliminates current creepage due to moisture or dirt infiltration between contacts. 3rd, Pins amd sockets in MINES Connectors are designed to maintain positive full length contact under vibration. 4th, Molded as one piece Neoprene rubber units, MINES Connectors won't crack or shatter under hard impact. Their tapered neck design provides extra strength at the vital cable connector junction and prevents dangerous wire fraying or breaks.

MINES Neoprene rubber Connectors will solve your magnet connector problems too. For a quotation give us the size and electrical characteristics of your magnets.

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MINES EQUIPMENT COMPANY

4257 CLAYTON AVE. MINES **ST. LOUIS 10, MO.**

HIGH TOP PRESSURE CONVERSIONS CONTINUED

▲ Operating results for two blast furnaces at Chicago and Warren, Ohio, which were recently converted to high top pressure operation, were announced recently by E. M. Richards, vice president of Republic Steel Corporation. Mr. Richards said that three more conversions are under way, one of them the Buffalo No. 2 furnace, to be completed in October. With the two recent conversions, Republic now has four furnaces operating on high top pressure, located at Cleveland, Youngstown, Warren and South Chicago.

Mr. Richards reported that operating results of the present four pressure furnaces confirm expectations of higher productivity and greater economy based on experimental operations begun in cooperation with Arthur D. Little, Inc., in 1944 and that mechanical difficulties encountered in the early experiments have been reduced so that lost time on a pressure furnace is now no more than on a normal blast furnace. Erosion of the bell and hopper was one of the early problems, but the hard-surfaced, one-piece hopper and the hard-surfaced bell on the Cleveland furnace have been used continuously for 26 months and are still in excellent condition.

The Chicago furnace, Mr. Richards said, has only been on top pressure for a period of three months, but broke its tonnage record in August by producing 3000 tons more than in any previous month since the furnace has been in operation. The Cleveland pressure furnace, operating on essentially a straight ore burden, has averaged 1250 tons a day for the last 6 months at a wet coke rate of 240 lb per ton of iron less than any other furnace in the Cleveland district. During the same period of operation the furnace has produced an average of only 117 lb of flue dust per ton of iron while being blown at a wind rate of 90,000 cfm. The Youngstown No. 3 pressure furnace for the same six month period has produced an average of 170 tons more from a day at a coke rate 300 lb less per ton of iron than the Youngstown No. 1 furnace of exactly the same size and operating on approximately the same burden but at normal top pressure.

In handling scrap—it's OHIO

BOLTED-TYPE MAGNET. Hefty construction. Bolts have recessed, positively locked heads. 12 to 65-inch sizes. Large sizes available with 6 or 8 coils.

In "rough service"—it's OHIO

PROTECTO-WELD MAGNET. Outer ring and top plate welded *on top of magnet.* Weld cannot be dented in or cracked. 36 to 65-inch sizes; 4, 6 and 8 coils.

IN ANY SERVICE — larger lifts all day long with OHIO Magnets

OHIO MAGNETS are tough... rugged...powerful. Whether bolted or welded, they feature heavier construction. Extra weight is distributed throughout heavy-duty copper coils, insulation and steel frame. And they're carefully sealed with plenty of non-cracking asphaltum compound...*cannot leak or "breathe".*

Result—Ohio Magnets operate cooler . . . lift more efficiently and uniformly over extended periods of operation...*last years longer.* For literature, write today to Ohio—*25 years a leader in magnetic materials handling.* The Ohio Electric Mfg. Co., 5900 Maurice Ave., Cleveland 4, Ohio.

Ohio MAGNETS

Personnel News...

A. S. Marvin has been appointed division engineer in charge of the Pittsburgh engineering department of American Bridge Co. Mr. Marvin succeeds **F. S. Merrill**, who will continue with the company on special engineering assignments. After graduating from the University of Colorado in 1924, Mr. Marvin began his employment with American Bridge as a draftsman at the company's Gary, Ind., plant. He later became an engineer in the Chicago division office. He came to the Pittsburgh office in 1947 as assistant division engineer, the position he held at the time of his present appointment.

James W. Moran has been elected president of Baker-Raulang Co. to succeed **E. J. Bartlett** who becomes president emeritus and continues as a director. The change was effective January 1, 1949. Mr. Moran who is a native Clevelander joined the company in 1911 as a clerk in the stock record department. After being employed successively in the service, purchasing and accounting departments, in 1916 he became auditor. In 1920 he was elected assistant treasurer and, in 1934, secretary, treasurer and director.

Mr. Bartlett, who continues as a director and who will serve the management in an advisory capacity, was born on a Maine farm. After receiving his engineering degree from the University of Maine in 1902 he entered the automotive industry with the Electric Vehicle Co. of Hartford, Conn., who were manufacturing the Columbia Electric. In 1911 he began a 37-year period of service with the Baker-Raulang Co. in Cleveland, becoming assistant general manager in 1913, vice president and general manager in 1919 and president in 1925. Under Bartlett's guidance the company's business has prospered. A new plant with increased manufacturing facilities is under construction and will be ready for occupancy in the next few months.

Charles E. Agnew has been named blast furnace superintendent at the Buffalo plant of the Wickwire Spencer Steel division of the Colorado Fuel & Iron Corp. He formerly served in various capacities with Carnegie-Illinois Steel Corp. and American Steel & Wire Co.

Lemuel B. Hunter was named manager of the raw materials department at Inland Steel Co. He had been fleet manager of the company since 1943. Mr. Hunter joined Inland Steel Co. in 1937 following his graduation from Harvard University. Originally with the company's limestone operations at Port Inland, Mich., he later worked at the coal and iron ore mines of Inland, and just prior to moving into the company offices in Chicago in September, 1939, he was employed at the Indiana Harbor works of the company.

George H. Greene was named chief engineer of Bethlehem Steel Company's Johnstown, Pa., plant. Mr. Greene succeeds **W. C. Frank** who has retired. **T. M. Fairchild** was appointed superintendent of Franklin mills at Johnstown. **D. L. McBride** was made superintendent of the open hearths at Franklin mills and **G. L. Owens** and **G. V. Metzler** were named as assistants to Mr. McBride. **F. R. Pullen** was named fuel engineer.

Edward O. Murray, district purchasing agent for Bethlehem Steel Co. at Johnstown, Pa., has retired.

Robert M. Whitney was promoted to the position of advertising manager of the Automatic Transportation Co., Chicago, Ill. Mr. Whitney had been assistant advertising manager for Automatic since 1945. He joined the firm in 1936 in the engineering department, and in 1939 was transferred to the sales department. He has been associated with Automatic's advertising program since 1944.

William J. Healey has been appointed superintendent of transportation at the Brier Hill works of Youngstown Sheet and Tube Co., Youngstown, Ohio. He succeeds Herbert E. Johnson who recently was appointed to a new position of superintendent of transportation for the company's Youngstown district. Mr. Healey, who began working as a department store messenger at the age of 14, joined Youngstown Sheet and Tube Co. in 1910 as a yard clerk. Two years later he became yardmaster and in 1929 was made general yardmaster.

James M. Lewis was named manager of roll sales for Lewis Foundry and Machine division of Blaw-Knox

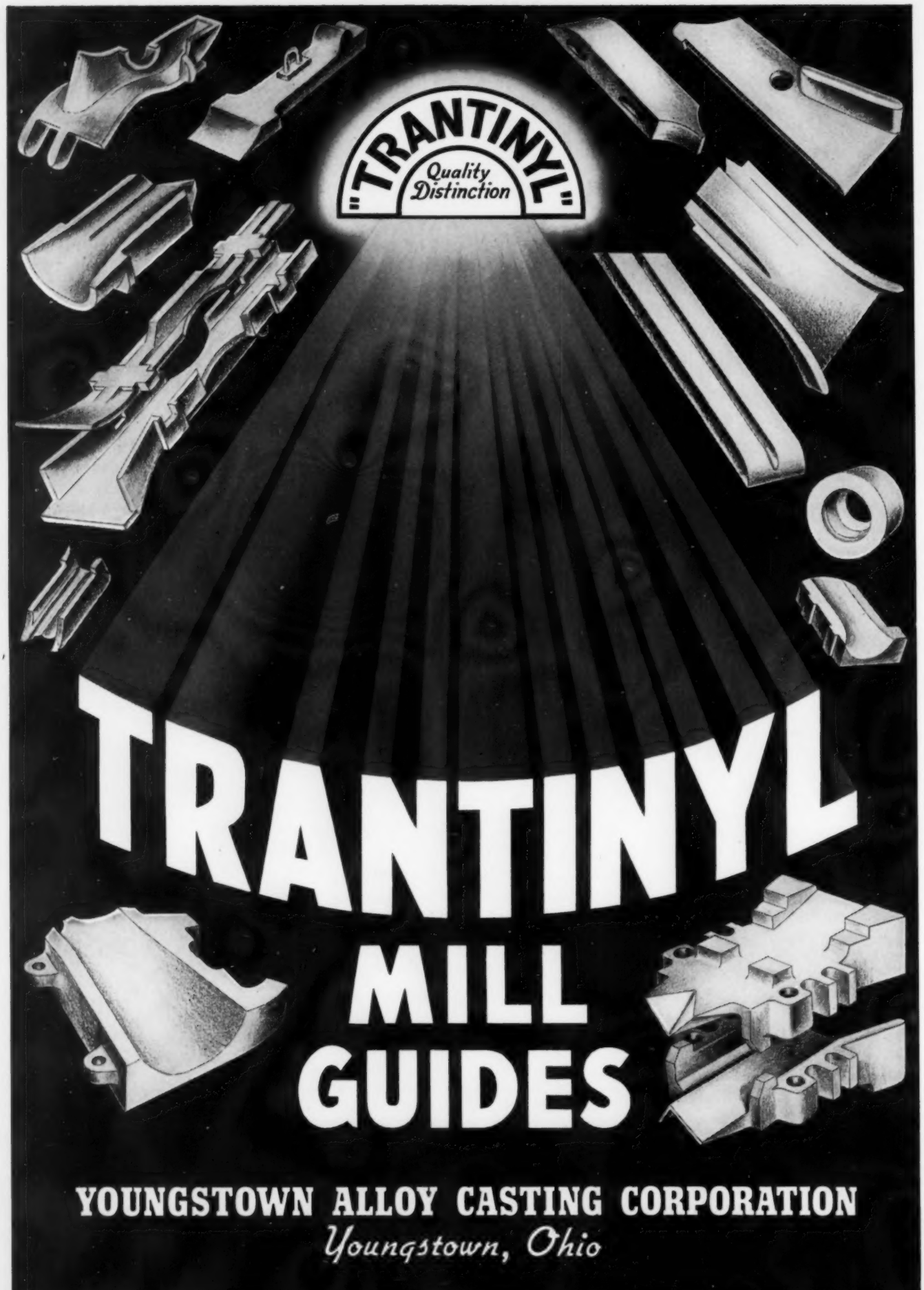
(*Please turn to page 152*)

A. S. MARVIN

JAMES W. MORAN

E. J. BARTLETT

JAMES M. LEWIS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YOUNGSTOWN ALLOY CASTING CORPORATION
Youngstown, Ohio

● *Both back-up rolls and work rolls of this 4 High Aluminum Rolling Mill, designed and built by United Engineering & Foundry Company, are equipped with SKF Spherical Roller Bearings.*

Among the BIG mills, the use of **SKF** Spherical Roller Bearings is not confined to roll-necks, but is widely adapted to tables, screwdowns, gear drives, etc.

The rolling alignment of **SKF** Spherical Roller Bearings compensates for machining and setup errors and accommodates shaft deflections, distortions, or weave. Maximum load carrying capacity is available for useful work at all times. No adjustments are required.

Originators of self-aligning bearings, **SKF** provides spherical roller bearings in bore sizes from 1.1811" up, straight or tapered bore, with or without adapter mounting.

For the latest information, send for Catalog No. 280, second edition. 6541

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DE LAVAL GEAR REDUCERS *in* STOCK

CRATED FOR IMMEDIATE SHIPMENT

WG-22

These popular units are assembled, crated and ready for immediate shipment.

Reducer	*Ratio*	*Probable *HP Motor*	*Reducer*	*Ratio*	*Probable *HP Motor*
BW400	9⅔	5	BW600	11⅔	10
BW400	19½	3	BW600	19½	7.5
BW400	25	2	BW600	25	5
BW400	40	1.5	BW600	40	3
BW500	11⅔	7.5	BW700	9⅔	15
BW500	19½	5	BW700	19½	10
BW500	25	3	BW700	25	7.5
BW500	60	1.5	BW700	40	5

** Based on 1750 rpm—A.G.M.A. Class 1 Service. For other rpm's or Service refer to De Laval rating tables.*

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Cleveland, Ohio Henderson 7500
Denver, Colo. Main 0697
Detroit, Mich. Madison 0950
Houston, Texas Wentworth 3-2823
Indianapolis, Ind. Albert 9433
Kansas City, Mo. Harrison 0744
Los Angeles, Calif. Michigan 6003
New Haven, Conn. New Haven 8-3459
New Orleans, La. Raymond 0228
New York, N. Y. Bowling Green 9-1550
Philadelphia, Pa. Rittenhouse 6-8086
Pittsburgh, Pa. Court 5400
Rochester, N. Y. Stone 6950
St. Paul, Minn. Garfield 1836
Salt Lake City, Utah Salt Lake City 3-7933
San Francisco, Calif. Sutter 3426
Seattle, Wash. Elliott 3437
Tulsa, Okla. Tulsa 5-2151
Washington, D. C. National 9238

DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

(Continued from page 149)

Co. Mr. Lewis has been with Blaw-Knox since 1931 and has been connected with the roll industry for a total of 25 years. He is an alumnus of Mercersburg Academy and Grove City College. He also attended law school at Duquesne University.

John P. Wilkinson was appointed assistant to the president of Lewis Foundry and Machine division of Blaw-Knox Co. Mr. Wilkinson comes to Lewis Foundry and Machine from Mexico City, where he recently

JOHN P. WILKINSON

supervised the installation of a new merchant mill for Aceros Nacionales. He has been employed in the steel industry in the United States in various capacities for 12 years. He attended the University of Alabama.

Leonard H. Loufek was appointed industrial manager of the central district for Westinghouse Electric Corp. Mr. Loufek succeeds **C. H. Weaver,** who has been named manager of the company's newly-formed atomic power division. A native of Cedar Rapids, Iowa, Mr. Loufek was graduated from Iowa State College in 1930 with a B.S. degree in electrical engineering. He joined the Westinghouse graduate student training course in July, 1930. After serving as a salesman in the Johnstown, Pa., office, he was transferred to the central district industrial division at Pittsburgh in 1933 and was appointed assistant industrial manager in February, 1947.

James A. Whiting has been appointed assistant superintendent of Hubbard, Ohio, blast furnace of Youngstown Sheet and Tube Co. Mr. Whiting, a native of New Bedford, Pa., joined the company as a laborer in the Campbell blast furnace department in 1937. Later that year he became a stoveman, a booster operator in 1939 and a junior blower in 1940. From 1942 to 1945 he served in the United States Navy. He returned to the blast furnace department in 1946 as a junior blower, became a practice man a short time later and held that position until his recent promotion.

John D. Anderson has been appointed assistant superintendent of the rod, wire and conduit departments at the Struthers, Ohio, plant of Youngstown Sheet and Tube Co. Mr. Anderson, a native of Avalon, Pa., joined Youngstown Sheet and Tube Co. as an inspector in the sheet galvanized department September 13, 1926. The following year he became an inspector in seamless chipping, in 1928 was made assistant foreman of seamless

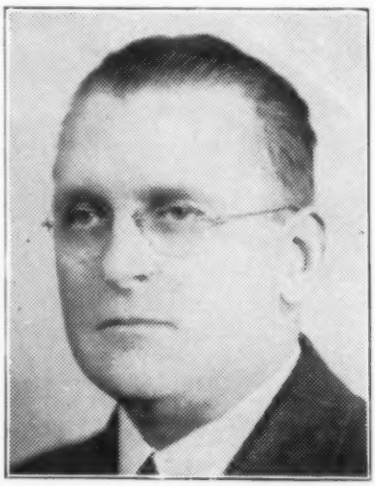
chipping and in 1930 foreman of the merchant mill chipping yard. From 1930 to 1934 he was clerk in the inspection department, butt and lap weld; became foreman in 1935; was general foreman of seamless inspection in 1935 and 1936; general foreman of the Campbell plant inspection in 1936-37; assistant chief inspector from 1937 to 1944 and assistant superintendent of the Struthers merchant mills from 1944 until his recent promotion.

Robert M. Arnold, a director, was elected to a newly created vice presidency of Allegheny Ludlum Steel Corp. Mr. Arnold is also president of Arnold Engineering Co., of Chicago, a wholly owned subsidiary. Mr. Arnold, educated at the Massachusetts Institute of Technology, has served as a director of Allegheny Ludlum since September, 1946, and as president of Arnold Engineering Co., producers of permanent magnets, since 1941. He has a rich background in electronics and the manufacture of magnetic and electrical steels. In 1922, he was employed with a Chicago firm of consulting engineers dealing in electronics and later as chief engineer of radio manufacturers in this country and England. Mr. Arnold became secretary and chief engineer of Arnold Engineering Co. in 1935 and was named its president six years later. His company was acquired by Allegheny Ludlum in January, 1946.

Robert Hutchinson was appointed application engineer for Kennametal, Inc., in the central district. His headquarters will be at 860 Hanna Bldg., Cleveland, Ohio.

C. E. Stone has been elected president of Chemsteel Construction Co., Inc., located at 5428 Walnut St., Pittsburgh, Pa. Mr. Stone formerly was sales manager of Atlas Mineral Products Co., Mertztown, Pa. The new company was purchased from Atlas Mineral Products Co.

Harald M. Olson, water treatment engineer, water equipment designer, salesman, and maintenance engineer for over 39 years, has been named consulting

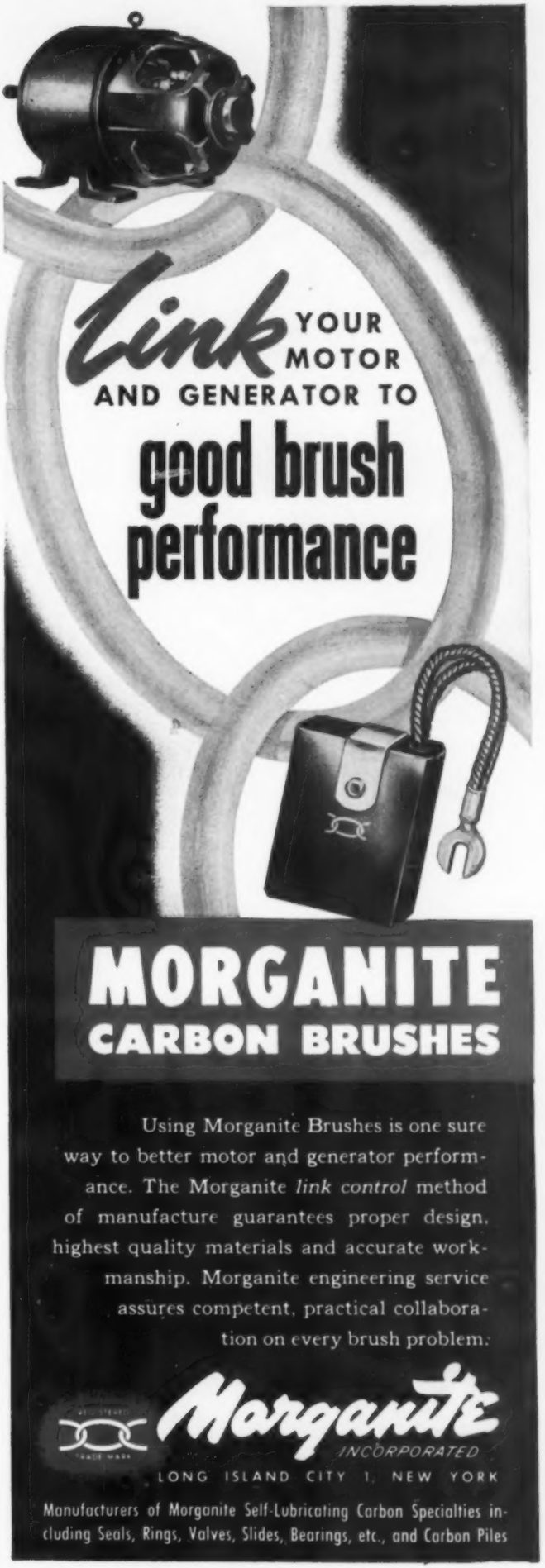


HARALD M. OLSON

maintenance engineer for the Morton Salt Co., 120 South LaSalle Street, Chicago, Ill., general office, effective January 1, 1949.

Fred S. Ehrman, general sales manager of Bowser, Inc. since 1944, has been elected to the newly created post of vice president and director of sales. Mr. Ehrman has been associated with Bowser, Inc. since 1925, and

(*Please turn to page 156*)


Link YOUR MOTOR AND GENERATOR TO
good brush performance
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CARBON BRUSHES
Using Morganite Brushes is one sure way to better motor and generator performance. The Morganite *link control* method of manufacture guarantees proper design, highest quality materials and accurate workmanship. Morganite engineering service assures competent, practical collaboration on every brush problem.
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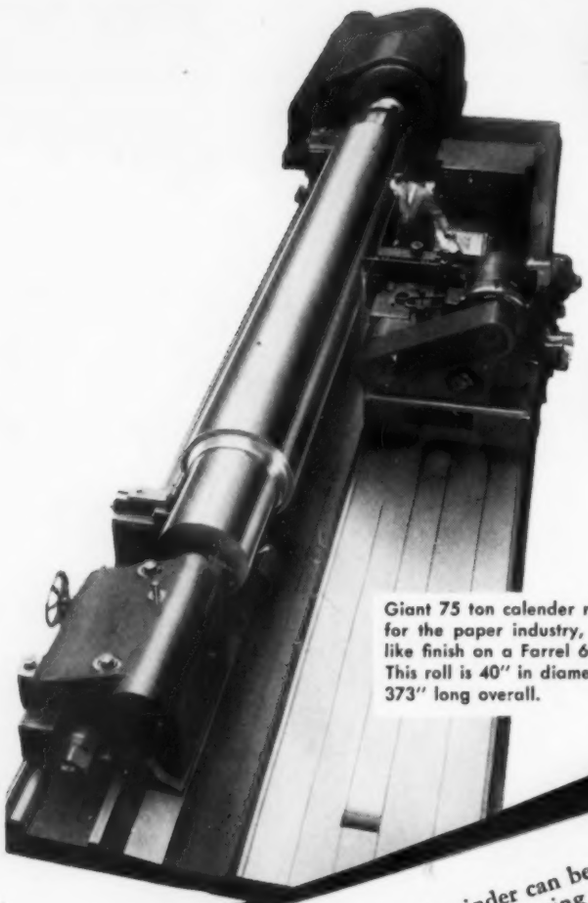
Manufacturers of Morganite Self-Lubricating Carbon Specialties including Seals, Rings, Valves, Slides, Bearings, etc., and Carbon Piles

why *Farrel* grinders bring roll maintenance costs down



Giant 75 ton calender roll, heaviest ever produced for the paper industry, being ground to a mirror-like finish on a Farrel 60-inch, heavy duty grinder. This roll is 40" in diameter, has a 276" face and is 373" long overall.

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For the story of "how" all these roll maintenance helps are possible, write for Bulletin No. 115 which describes in detail the many features of the Farrel heavy duty roll grinder. A copy of this NEW *bulletin will be sent to you without cost or obligation.*

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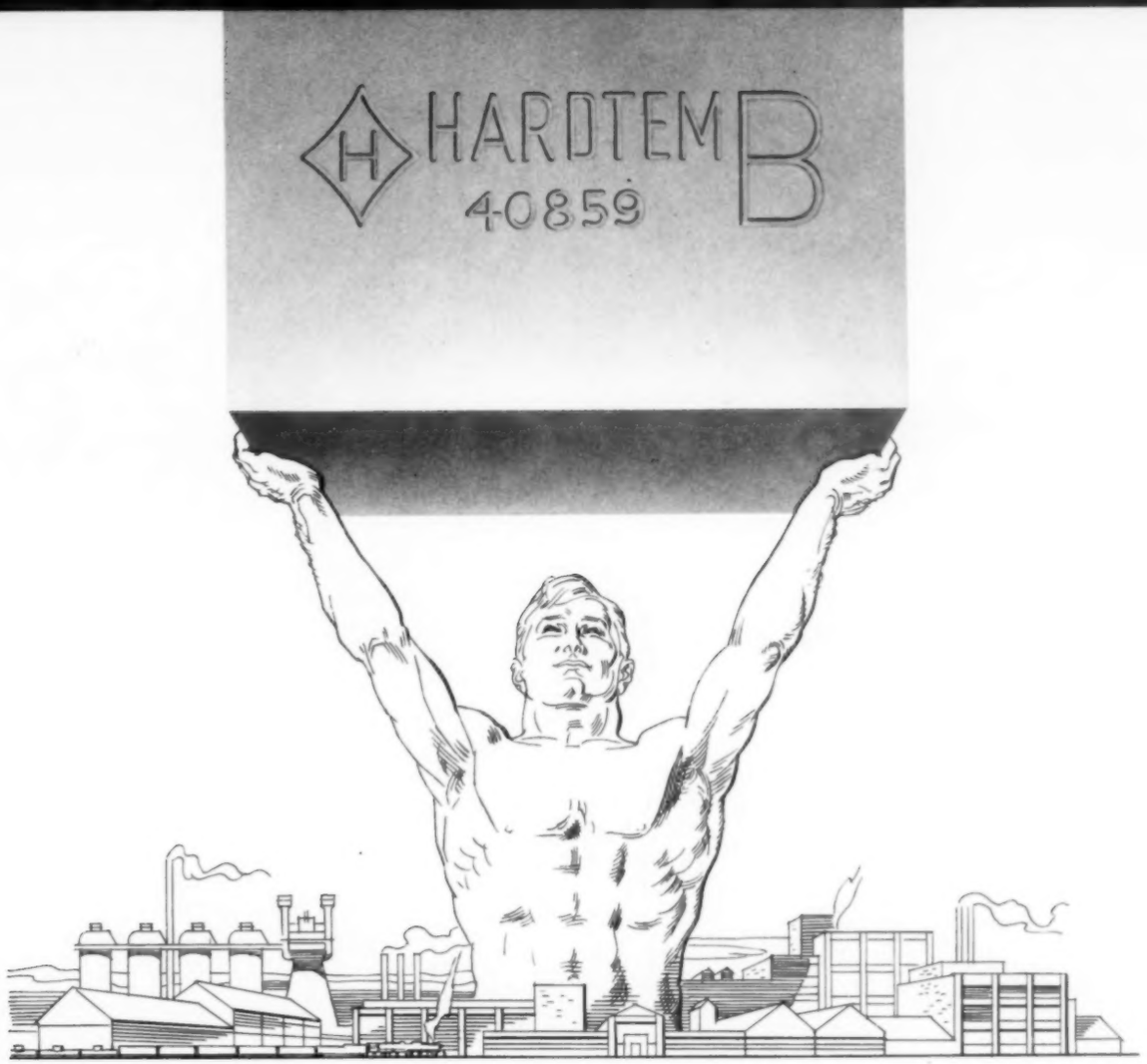
ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Chicago, Los Angeles, Tulsa, Houston

Farrel-Birmingham

FB-472



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(*Continued from page 153*)

has served successively in experimental engineering, sales engineering and divisional sales work.

Robert K. Follansbee has been elected vice president in charge of sales of the Follansbee Steel Corp. Mr. Follansbee had been secretary and treasurer of the cor-

ROBERT K. FOLLANSBEE

poration, with which he has been connected for 20 years. He started his career with the company as an employee in the plant at Follansbee, W. Va., after attending Carnegie Institute of Technology.

Frank E. Early was named representative for Askania Regulator Co. in the Detroit, Mich., area effective January 1, 1949. Mr. Early, who has worked with Askania and Askania equipment in various capacities since 1936, will represent the company for all its products. His address in Detroit is 15234 Michigan Avenue, Detroit, Mich.

Ivan L. Hall was elected vice president of New York and New Jersey Lubricant Co., and **Sidney Vollman** was elected treasurer and **James F. Donlin** was named assistant treasurer.

Hugh F. Beeghly, research engineer with Jones & Laughlin Steel Corp., recently returned from Oak Ridge, Tenn., where he has been attending a course in the techniques of using radioisotopes—or "tracer atoms"—in research. Mr. Beeghly has been investigating the application of radioisotopes to researches in the manufacture and fabrication of iron and steel. Radioisotopes have been called the greatest research tool to be developed since the invention of the microscope. Mr. Beeghly attended the fourth of a series of one-month courses being offered by the Oak Ridge Institute of Nuclear Studies to acquaint scientists throughout the country with the methods of using this important new research tool safely and efficiently. The Institute, comprised of 19 southern universities, conducts a broad program of research and training in the nuclear sciences in cooperation with the Atomic Energy Commission. Mr. Beeghly, a graduate of West Virginia University, has been with J & L as a research worker for the past 12 years.

George B. McMeans was appointed general superintendent of the steel plant at Kaiser Co., Inc., Fontana, Calif. Mr. McMeans joined the Kaiser organization in February, 1947, as assistant general superintendent. He

Industry News...

CURRENT EXPANSION AT JONES & LAUGHLIN IS LARGEST IN ITS 97-YEAR HISTORY

▲ The post-war plant improvement program of Jones & Laughlin Steel Corp. is the largest in its 97-year history. Every phase of steel production from ore mines through finishing mills is affected by the program which now provides for estimated expenditures totaling more than $210,000,000. The corporation is spending on improvements and rehabilitation in this post-war program an amount equal to two-thirds of the corporation's gross plant value at the end of the war.

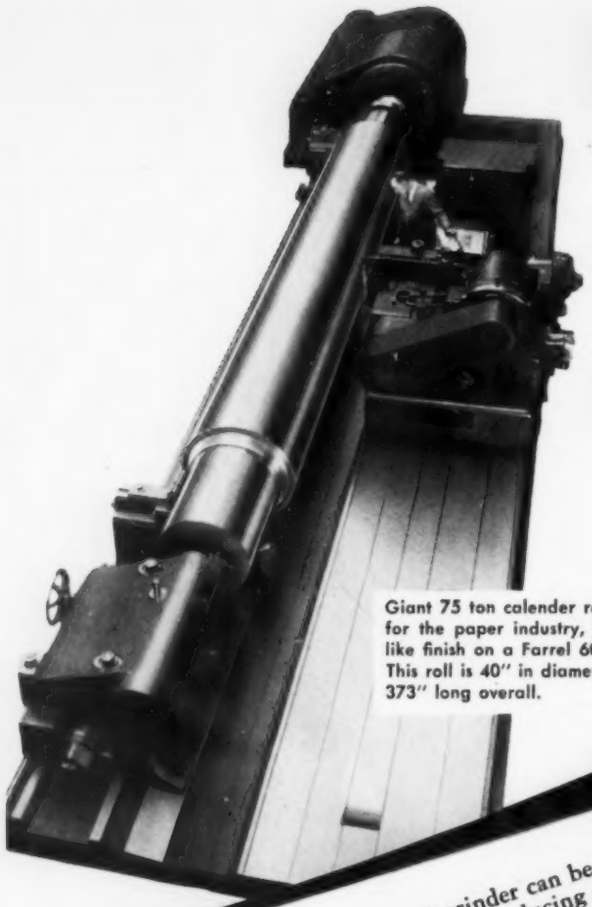
Major phases of the program to be undertaken or completed next year are:

1. Completion of the world's largest coal washer at Vestaburg, Pa. Consolidation of Vesta No. 4 and Vesta No. 5 mines into the largest underground coal mine in the world.
2. Construction of a new six-furnace open hearth shop in Pittsburgh, Pa., and the necessary corollary and finishing facilities at Pittsburgh and Aliquippa, Pa., works;
3. Construction of a new central boiler plant at South Side, Pittsburgh works, to replace five obsolete plants, is nearing completion. Two of the new boilers are operating and three more will be completed early in 1949.
4. The enlarging of No. 5 blast furnace at Pittsburgh has been started and will be completed in January, 1949. Installation of two additional turbo blowers at the blast furnaces is under way. One is in operation and the other will be in operation early in 1949.
5. An additional bessemer converter—bringing the total at Pittsburgh to three—is under construction and will be in production by the middle of 1949.
6. A program to expand and improve the hot and cold strip mill at the Pittsburgh works, has been started with the rebuilding and improving of slab-heating furnaces. The program includes installation of a new hot coil conveyor system, and additional cold finishing facilities.
7. Three five-hole blocks of soaking pits have been authorized for Pittsburgh works. One block will be completed during 1949. Sixty 100-ton slab rack cars to handle hot steel are being installed.
8. No. 1 blast furnace at Otis works will be enlarged and relined during 1949. A new turbo blower will be installed. Hot strip-sheet and cold rolling facilities will be modernized and expanded.
9. Major expenditures are under way at the corporation's ore mines in Minnesota, New York, and Michigan.

Part of the program is already completed and becoming effective. During 1948 the world's fastest rolling mill for cold reducing tin plate coils went into production at Aliquippa works. One of the world's largest batteries of coke ovens went into production at the Aliquippa works, and by-product facilities are being rehabilitated and enlarged. This was the second battery of this size to go into operation at Aliquippa in the past three years. New hot metal cars were installed and reladling pits built to

Construction of six open hearth furnaces, a short distance from the Pittsburgh, (Pa.) Golden Triangle business district, is planned by Jones & Laughlin Steel Corp. Location of the open hearth shop as part of J&L's South Side works is shown here. Together with the availability of additional iron resulting from blast furnace and raw material improvements, construction of these furnaces will result in a net increase of total ingot capacity at Pittsburgh works amounting to over 400,000 tons annually. Estimated cost of the project including necessary corollary and finishing facilities at Pittsburgh and Aliquippa (Pa.) is $70,000,000.

why *Farrel* grinders bring roll maintenance costs down



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Farrel-Birmingham

FB-472

Publication Service...

(1) Tapered Roller Bearings

Two booklets are available to you on tapered roller bearings. One is a 12-page booklet entitled, "The Story of The Better Tapered Roller Bearing," which describes the type of bearing manufactured by this company. Also included in this offer is a booklet entitled, "Anti-Friction Bearing Maintenance," which was compiled by the engineering committees of the Anti-Friction Bearing Manufacturers Association, Inc. This very complete book was prepared to meet the widespread demand for the conservation of bearings and to assist repairmen in the shops and field organizations to accomplish this purpose, as well as to provide information for the general handling of bearings. By following instructions given in this manual, new bearings will be protected from damage and usable bearings will be removed from worn-out equipment, properly cleaned and installed in the same or other equipment for further use. The instructions cover the types of bearings in most general use. Tyson Roller Bearing Corp.

(2) Silicone Fluids

A recently published booklet contains the most comprehensive body of information available on the properties and behavior of the D-C 200 silicone fluids. These semi-inorganic fluids are notable for their heat stability, shear resistance, relatively constant-viscosity over a wide temperature range, lubricity, water repellency and good dielectric properties. Their usefulness as damping and hydraulic media, as liquid dielectrics, as special purpose lubricants or as additives, impregnants or coatings has been established in almost every field of industry. After more than five years of experience in producing and helping to adapt D-C 200 fluids to a wide variety of uses, it is evident that the potential usefulness of these liquid silicones will not be fully realized for many years to come. Progress in that direction will depend upon the dissemination of such data as compiled in the tables, graphs, and text of this booklet. (3). Dow Corning Corp.

You Can Obtain...

... any of the bulletins reviewed in the Publication Service of the IRON AND STEEL ENGINEER without obligation or cost. Simply circle the desired item numbers on one of the prepaid postal cards and mail. The requests will be forwarded to the manufacturers involved who will send the bulletins to you.

(3) Machining Meehanite Castings

A new 20-page illustrated booklet entitled "How to Machine Meehanite Castings" has just been published. The bulletin presents in great detail an accumulation of machining data of various types of Meehanite castings, divided according to the type of machine tool on which the operation is performed. Its purpose is to be useful as a set-up guide and gives exact details as to feeds, speeds, depths of cut, type of tool, etc. (29). Meehanite Metal Corp.

(4) Corrosion-Resistant Concrete

A new booklet, "Lumnite Concrete Floors — Corrosion-Resistant & Heat-Resistant," has just been published. The detailed information contained in this latest booklet brings up to date the service experiences and late developments in the rapidly growing field of corrosion-resistant concrete. This basic information adequately covers both the methods and materials used in placing corrosion-resistant concrete in a wide variety of industrial applications. Typical uses of corrosion-resistant concrete are listed for many industries and also the answers to a number of questions often asked about it. A section on placing and finishing corrosion-resistant floors will be helpful to new prospective users of Lumnite. In addition to the floor applications, corrosion-resistant concrete is being successfully used in lining stacks, oil refinery vessels and drainage systems. Lumnite division of Universal Atlas Cement Company.

(5) Graphic Record of Vehicle Performances

A twelve page booklet recently issued by the Wagner Electric Corp. on the "Sangamo Tachograph" describes how practical savings and safety may be obtained in driving. The tachograph was developed to provide an instantaneous check on automotive truck speeds, miles traveled and on the time. This helps in improving driver efficiency, and complete specific knowledge of the vehicle's daily performance, time of operation, speed in miles per hour or rpm, and the distance traveled or total rpm is given in a graphic record. Two models are available, model A is available for 24 and 12 hour records for either 6–8 or 12–16 volt ignition systems. Model B records rpm and is available for 2300 or 3500 rpm engines, for 12 or 24 hour service, and for 6–8 or 12–16 volt systems. These tachographs when properly modified to be run on available power supplies an equipment rpm also offers interesting possibilities to check up on the performance of many items of steel mill equipment such as cranes, industrial trucks, etc.

(6) Storage and Handling of Lubricants

The January, 1949 issue of "Lubrication" includes a 12-page technical article on the "Storage and Handling of Lubricants." The article is one of the most complete articles on this subject ever written, and should be of value to all steel mill personnel interested in lubricant storage and handling. A copy of this issue will be sent to those circling this item number. The Texas Co.

(7) Low Cost Electric Melting

A bulletin is available describing "Hydro-arc" electric furnaces. The bulletin describes design, hydraulic power transmission, electrode arms and clamps, electrical and control equipment charging buckets, tilting mechanisms and triplexing. The tilting mechanism is illustrated by diagrams showing three different types of tilting methods available. Approximate space requirements for these furnace installations are given diagrammatically with preliminary layout dimensions. A tabulation is also included giving the various models with their hourly melting rates, kva ratings, inside shell diameter and the capacity recommended in pounds. Eight types of these furnaces are available for steel mill use. (FY-130). Whiting Corp.

(8) Standardized Unit Substations

How Allis-Chalmers new standardized load center unit substations pay off in power savings, better performance, greater safety and flexibility, easier installation and quicker delivery is told in a new 16-page bulletin released by the company. The bulletin includes a simple and flexible nomogram which makes it easy to select the correct air circuit breaker for any application of a standardized load center unit substation. Sizes and dimensions of load center unit substation transformers, vertical lift metal-clad switchgear and Type L switchgear with air circuit breakers together with space requirements of standard low voltage switchgear are given. The bulletin points out that transformers and metal-clad switchgear are not the only pieces of electrical equipment that can be packaged to save space and money and to provide better appearance and greater safety. Compact unit substations are also formed by combining transformers and switchgear with motor control and with power rectifiers. (Bulletin 11B-6285A). Allis-Chalmers Manufacturing Co.

(9) Coupling Selector

A new coupling selector was recently released, intended to be used by engineers, designers, plant engineers and the multitude of other men who are instrumental in the selection and purchasing of flexible couplings. This new coupling selector will take care of the selection of couplings from Falk sizes 3F up to size 18F. This handy new slide rule selection method makes it easy for a prospect to determine exactly which coupling size is correct for his application. The design of this selector is based upon the Falk three-dimensional method of selecting a coupling. That is . . . by horsepower . . . by application and by the rpm at which the coupling is to travel. This three-dimensional method of selection rather than the customary bore size selection makes certain that the coupling is absolutely correct for the job involved. Correlation of these three factors is made easy through use of this selector. Falk Corporation.

(10) Boiler Setting

A 48-page book on "Plibrico" boiler setting construction for water tube boilers is available to you. The book discusses the engineering services available, the boiler setting construction facilities, the method of installation, the setting for the various types of water tube boilers, suspended arches, castable refractory material, sectionally-supported air-cooled setting, solid walls and water walls. Concerning baffles, the following is described: vertical vs. horizontal, inclined vs. flame-plate, and cross baffles vs. parallel baffles.

The book describes how this company maintains in over one-hundred industrial centers complete installation and boiler setting services. This service consists of crews of competent and experienced boiler setting and installation men able to handle any type of work from a small repair job to a complete new boiler setting contract. Plibrico Jointless Firebrick Co.

(11) Automatic Production Control

A new 16 page booklet, entitled "Reeves Automatic Production Control," has just been released. Of particular interest to machine designers, builders and users, the booklet, which is fully illustrated with photographs and drawings, discusses in detail the functions of automatic production control and the means of applying it to production machinery through use of the Reeves variable speed transmission and the "Motodrive" in conjunction with automatic controls. Described in the booklet are hydraulic automatic control, mechanical automatic control and differential automatic control; also various speed indicating mechanisms such as the floating roll, follower roll, pressure regulator, diaphragm regulator, float regulator, bubble pipe regulator and others. (GN-487). Reeves Pulley Co.

(12) Care and Use of Chain

Just completed is a new booklet on the "Inspection, Care and Use of Taylor Made Alloy Steel Chain." The contents include: a check list of things to look for when inspecting chain in your plant; factors that enter into and govern the proper use of chain; a plan for assuring your chain the necessary care; a table giving the maximum wear limits for each diameter of chain; the safe-working load limits of each size of chain and the correct methods of repairing alloy steel chain. The booklet is offered to enable users to receive the maximum safety and the maximum service from their chain. S. G. Taylor Chain Co.

(13) "Cartridge" Ball Bearings

A new 28-page booklet on "Cartridge" ball bearings has just been released. The booklet describes the many applications of this versatile bearing, dimensional data, load rating, dirt protection, grease type, content and retention, and the bearing's remarkable ten-year service record without relubrication. Norma-Hoffmann, Bearings Corp.

(14) Specialized Transportation

Literature and other information is available on specialized materials handling and transportation equipment. This company is set up to design, engineer and build transportation and materials handling equipment to meet specific problems. If you have a problem of handling raw materials, parts, finished product or waste, we suggest that you obtain this information. Easton Car and Construction Co.

(15) "Lo-Hite" Hydraulic Jack

A bulletin describing the new Duff-Norton "Lo-Hite" hydraulic jack in detail is available. Oil in the new "Lo-Hite" jack is sealed-in completely isolated from the jack exterior thus permitting use in both vertical and horizontal positions. The total weight of the jack is 38 lb. When not in use the 30-ton capacity "Lo-Hite" folds into a compact easy-to-carry unit. Duff-Norton Manufacturing Co.

(16) Ventilating Fans

Although this is January it is not too early to think of the fans you will need for cooling your products to speed production or keeping your workingmen cool. A very complete catalog has been prepared on continuously operating fans. The catalog includes tabular information performance curves and illustrations of the various types of fans blowers and exhausters manufactured by this company. These fans utilize a new method of fan design calculation and can be built of any dimension within the limits of each type to suit the specific condition for which the fan is desired. (2101). Robinson Ventilating Co.

(17) Plant and Furnace Design

A new brochure is available illustrating and describing the scope of activities of Loftus Engineering Corp. This brochure illustrates their line of furnaces and complete plants from the open hearth furnaces used to melt and refine steel through to the finished primary steel product and from there on through various types of heat treating equipment and heat treating lines to the final production item. Loftus Engineering Corp.

(18) Tube Mills

A book is available describing electric resistance weld tube mills. This book discusses the approximate cost of a tube mill its potential production minimum tonnage required for profitable operation and amount and skill of labor required. It endeavors to answer as specifically as possible the foregoing questions. These answers are based upon this company's experience in dealing with manufacturers all over the world for whom in the past ten years they have installed over one hundred of the tube mills described. Included in this book are several tables one of which gives forming and welding capacities of the type of tube mills described. There is a formula for calculating strip widths for definite sizes of tubing. Another section tells of the advantages of doing your own slitting. Every steel mill operator and engineer interested in the making of tube should have this very complete publication. (66 pages). Yoder Co.

(19) Rust Preventive

Two folders are available to you on rust preventives. The first describes a "No-ox-id" aluminum protective coating. This coating is a bright attractive aluminum, colored protective coating of exceptional durability. It is resistant to abrasion fumes and mild chemical attack.

The second booklet on rust preventives is entitled: "No-ox-id" 558. This is a highly effective oily type rust preventive easily applied to machined surfaces of all types. It gives excellent protection with an extremely thin transparent oily film. Dearborn Chemical Co.

(20) Worm Gear Drives

A new bulletin is available discussing "Hypower" and enclosed worm gear drives which are certain to give important reductions in space, weight, with power delivered at lower cost. The units described are smaller and more compact in design than conventional worm gear reducers. Their high capacity permits the use of a smaller reducer than would usually be required. The booklet contains descriptions on a wide range of ratios to meet practically any need, including data on selection, ratings and dimensions. A section is included on typical applications of these units. (HPA). Foote Brothers Gear and Machine Corp.

(21) Electrical Fitting Handbook

A most complete catalog is available on conduit fittings and solderless connectors. Included in the catalog are listings of cast iron boxes, terminators, power connectors and grounding devices, as well as several other electrical items. This catalog is virtually a handbook on electrical equipment, it has a very complete section containing useful engineering data which comprises tabular information, conversion tables and formulae. An up-to-date, 30-page price catalog is also included. (125). O-Z Electrical Manufacturing Co., Inc.

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53	POOLE FOUNDRY AND MACHINE CO.		Catalog on Flexible Couplings
54	RELIANCE ELECTRIC AND ENGINEERING CO.	Bulletin C-130	Precision Built Motors
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Book Reviews

▲ Hydraulic Institute announces the publication of a comprehensive Tentative Standard on Pipe Friction. The very latest data have been used to prepare tables and charts arranged in a convenient and usable form. This material will be of unusual interest to everyone concerned with the flow of fluids in pipes, as it is the result of one of the most progressive programs undertaken in years.

Hydraulic Institute, in 1946, felt that further work was required to present this data so as to permit widespread usage. With the cooperation of Prof. Clifford P. Kittredge, of Princeton University, who investigated the subject, and with the help of its members, Hydraulic Institute prepared convenient and usable tables

The friction loss for water is shown in the new Hydraulic Institute tables in tabular form for pipe sizes from ⅛ to 84 in. On the smaller pipe sizes, the tables are based on wrought iron or steel schedule 40 pipe, and for the larger sizes, separate tables are given for each standard size for steel and asphalt dipped cast iron pipe. In each table, the flow in gpm and cfs are shown with the corresponding velocity, velocity head, and friction loss per 100 feet of pipe. The data is carried to three significant figures and is listed in small increments to avoid the necessity for interpolation.

For computing the friction loss for liquids other than water, a series of charts are provided for pipes ranging from ½ to 12 in., showing the complete range of viscous and turbulent flow.

In addition to the friction tables, there is a very complete listing of the losses in valves and fittings. Sectional diagrams of these items are shown to indicate their internal construction. Since there is a lack of uniformity, a range of loss coefficient is given. The data for bends, increasers and diffusers are shown in chart form so as to include the full range of the variable dimensions. This data was assembled from a number of sources and represents the latest and most complete compilation.

The above publication may be purchased at $1.50 per copy. This price includes delivery within the United States. Orders should be addressed to the following: Hydraulic Institute, 90 West Street, New York 6, N. Y.

▲ Circular 460, Publications of the National Bureau of Standards, listing all Bureau publications from 1901 to June 30, 1947, has just become available from the Superintendent of Documents.

Bureau publications listed in the Circular include mathematical tables, building materials and structures reports, circulars, handbooks, commercial standards, simplified practice recommendations, research papers, and miscellaneous publications. Brief abstracts for the publications issued from January 1, 1942, to June 30, 1947, are also included. Circular 460, Publications of the National Bureau of Standards, 375 pages, can be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at a cost of 75 cents a copy.

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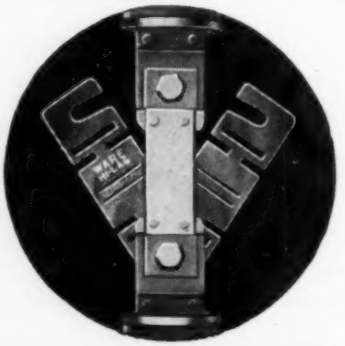

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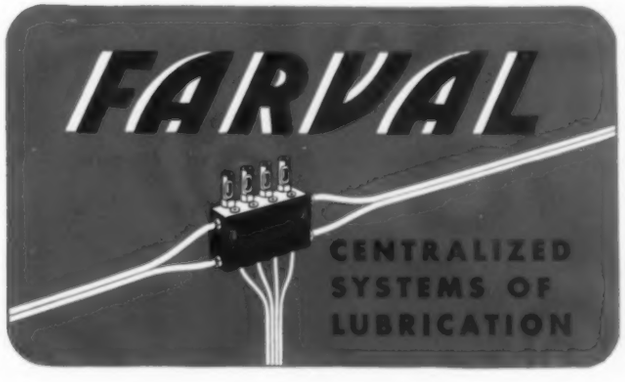

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